AUSTRALIAN AND NEW ZEALAND INDUSTRIAL AND APPLIED MATHEMATICS CONFERENCE
OPENING SPEECH BY
HER EXCELLENCY PROFESSOR THE HONOURABLE KATE WARNER AC
GOVERNOR OF TASMANIA
HOTEL GRAND CHANCELLOR, HOBART, MONDAY 5 FEBRUARY 2018

Good morning and welcome to the 2018 Australian and New Zealand Industrial and Applied Mathematics Conference.

I begin by paying my respects to the Mouheneener people, the traditional and original owners of this land—those who have passed before us; and in acknowledgement of today's Tasmanian Aboriginal community, being the custodians of this land.

I have seen from your website that ANZIAM is a division of the Australian Mathematical Society and that your focus is on applied mathematical research, maths applications in business and industry and maths education at tertiary level.

I have to begin with a disclaimer. My background is in law. It has been noted that there are three kinds of lawyers: those that count and those that cannot. So it is clear which category I fall in! And it is highly unlikely, then, that I can say anything at all that is relevant and deserving of your attention. So feel free to spend your time more productively by checking your phones for messages or emails. I won't be offended.

I would like to make a few comments about the importance of maths education, uncomfortably aware that your interest in maths education at tertiary level probably means maths education for tertiary maths students rather than maths education in general.

Since I have been Governor of Tasmania, I have been prompted to think and read about education more broadly than when I was a legal educator. First, because I am Chair of the Advisory Committee of the Underwood Centre for Educational Attainment, which aims to remedy the underperformance of Tasmanian students in comparison with their mainland counterparts.

Secondly because my interest in gender equality, which as a criminal lawyer and criminologist was focused on women as victims of physical and sexual abuse, has, in my current role, broadened to include the reasons for gender inequality, including in employment.

It is clear that among the reasons for the gender pay gap in Australia, currently 15.3%, is the fact that despite more women graduating from university than men, women are under-represented in higher paid STEM industries.

Why is there this occupational segregation? Why are there disturbingly low levels of female student participation in STEM subjects at schools, given that so many jobs in the future are going to be created for students who have the educational benefits of computational thinking skills?

If I think back to my schooldays, it was okay for girls not to be good at maths. We were channelled early into quite narrow areas of study — called 'streaming' 50 years ago but the primary meaning of that word has changed of course. I showed an aptitude for languages and biology (not a maths-intensive subject) and so this is where I was directed. This was encouraged and rewarded by sound results in those areas and that reinforced my interest in them.

I was not actively discouraged away from maths (or physics and chemistry) but I was not dissuaded from an early lack of interest by exciting teaching or by advice as to the importance of studying maths and the hard sciences for a well-rounded education. And I could balance my lack of effort in maths by putting effort into what came more easily to me.

As it happened my academic career in criminology and in sentencing law, with its frequent reliance on statistics to analyse changing patterns of offending and criminal justice responses and risk assessment, would have benefited greatly by a strong grounding in mathematics. And I am sure my story is not unique.

So what can be done to address the cultural biases and gender stereotyping that make it OK for girls to opt out of maths? For it seems that 50 years later this is still an issue. The fact that girls today are still under-represented in STEM subjects at school suggests we still have a problem.

And that is not the only problem. Experts are worried that the growing number of students (male and female) turning their backs on maths and science will be ill-prepared for the technology-driven jobs of the future. According to the

Australian Council for Education Research, maths achievement and engagement has been declining for more than a decade, and Australia is being leapfrogged by other nations.[i] In Australia, the participation rate in advanced maths has decreased from 14.2% of Year 12 students in 1995 to 10% in 2014.[ii]

It seems that years of publicising the importance of STEM subjects to future-proof our economy has done little to boost interest in mathematics. There are now substantial numbers of students completing secondary school without any maths. The level of maths that students are choosing is also dropping.[iii]

So there are two problems that we need to confront: first, the decline in maths achievement and maths engagement — and secondly, the under-representation of girls studying maths. It seems they are outnumbered by boys at 2:1, a ratio unchanged since 1981.

Addressing the decline in maths achievement and engagement

Here I would like to cite the work of Kim Beswick, a Professor in Mathematics Education at the University of Tasmania. Kim asserts that what a teacher believes influences the way they teach.[iv]

In mathematics education, too many teachers see their role as sorting kids, not teaching kids. Students are classified into those who get it, and those who don't.

The reality is that, in many cases, the failure is not only on the learning side of the equation, it is on the teaching side as well. Too many people are scared of maths. Kids who think they can't learn it often don't, even though they have the ability to do so. The first role of the teacher is to convince kids that they can learn maths; and then teach them accordingly.

Beswick argues that we should not use classifications to explain low achievement. We also have no right to decide which kids can access which parts of the curriculum. Moving students to lower levels of maths with lower expectations closes doors on futures which require maths.

Another problem according to Beswick is that teachers often don't have a deep enough knowledge of maths themselves. She argues that to teach maths well, you need to understand it really well. You need to be able to ad lib, to make it interesting. You need to know enough to know that when a kid solves a problem

in a different way, whether that will work for them long-term or whether that will get them into difficulty when the maths becomes more complex.

I am aware that there are many approaches to the problem of lack of engagement with maths that are being explored, including teaching quantitative reasoning with a project-based learning context, rather than learning maths in more traditional settings.[v]

How exciting it was to see Eddie Woo, the maths teacher from Sydney's Cherrybrook Technology High School made Australian Local Hero of the year for 2018 in recognition of his work in helping kids learn maths through video tutorials on his YouTube channel.

What about the second problem: under-representation of girls studying maths?

This is a problem that is not confined to Australia. In Australia, the Advanced Mathematics participation rate for Year 12 girls in 2015 was about 6.9% for girls but 12.6% for boys.[vi] It is widely recognised that gender differences in participation are not related to ability but are socially determined by gendered stereotypes influencing students' interests, societal expectations, students' confidence and even their performance.

At least two meta-analyses have shown no differences in maths abilities between girls and boys.[vii] And a meta-analysis using cross-national data from PISA and TIMSS found very little gender differences overall.[viii]

PISA shows there are differences between boys and girls in confidence and anxiety levels in relation to maths ability, with girls having less confidence in their ability to solve maths problems than boys, and greater feelings of anxiety towards maths.[ix] This is supported by other research into the self-concept of own ability in decisions to pursue challenging maths courses above and beyond measures of ability.[x]

The OECD report suggests that parents can help by giving their sons and daughters equal support and encouragement in all aspects of the school work and their future aspirations. PISA results show the parents of students who sat the PISA test were more likely to expect their sons, rather than their daughters, to work in science — even when their 15-year-old girls and boys performed at the same level.[xi]

The report also suggests that teachers can help by becoming more aware of their own gender biases, which may affect the way they award marks to students. They could also use teaching strategies that demand more of their students, since all students, particularly girls, perform better in maths when their teachers ask them to try to solve maths problems independently.[xii]

Building girls' self-confidence in maths is clearly important: it is suggested that because girls tend to perform so well in reading, this can lead them to unconsciously believe they are underperforming in other subjects, and hence undermine their confidence and performance. Females need to know that they are scoring as well as males in mathematical performance, and that they can expect to be successful in mathematics-intensive careers.

This supports Kim Beswick's views about the corrosive effects of channelling students into lower levels of maths. In fact it has been suggested we give students too much choice in Australia in terms of participation in core STEM disciplines in high school.[xiii]

There is a wealth of research into this important question of why women remain under-represented in mathematically-based occupations, and attention is being given to ways to counteract the obstacles to greater engagement of girls and women in maths and in mathematics-intensive careers.

I applaud this research and that which aims to ensure that maths is taught more effectively, so that we can have a truly mathematically literate society.

I now have great pleasure in declaring open the 2018 Australian and New Zealand Industrial and Applied Mathematics Conference.

Thank you.

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[i] Nadia Daly, 'Australian students are turning their backs on maths and science, and experts are worried' ABC News, 22 October 2017, http://www.abc.net.au/news/2017-10-22/australian-students-turning-their-back-on-maths-and-science/9074114 accessed 24 January 2018.

[ii] [ii] It was 9.6% in 2015: F Barrington and M Evans, *Year 12 Mathematics Participation in Australia – the Last Ten Years*, 2016, http://amsi.org.au/publications/participation-in-year-12-mathematics-2006-2016/ accessed 24 January 2018.

[iii] Daly n 1.

[iv] Kim Beswick's Profile, University of Tasmania, http://www.utas.edu.au/profiles/staff/education/kim-beswick accessed 24 January 2018.
[v] Tacey Muir et al, 'Experiencing teaching and learning quantitative reasoning in a project-based context' (2016) 28(4) *Mathematics Education Research Journal* 479-501.
[vi vi] Barrington and Evans, n ?.
[vii] Helen G Watt et al, 'Mathematices – a Critical Filter for STEM-Related Career Choices? (2017) 77 *Sex Roles* 254-271, 256.
[viii viii] Watts, n 7, 256. Contrast this with finding based on PISA 2012, which across OECD participating countries in 2012 found 15 year-old boys out performed girls by an average of 11 score points and in the top 10% of students the gender gap averaged 20 score points.[viii] In no country did girls outperform boys at this level although in some of the top-performing countries and economies in PISA, such as Hong Kong, Shanghai and Singapore, girls performed on a par with boys and there was no difference in Finland: OECD, *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence*, 2015 based upon PISA 2012, 20.
[ix] OECD, n 8, 14, 64. It has been suggested that if students are more self-confident, they give themselves the freedom to fail, to engage in the trial and error processes that are fundamental to acquiring knowledge in mathematics and science.
[x] Watt et al n (2017).
[xi] OECD, n 6, 15.
[xii] OECD, n 6, 15, 138, 158 (where using metacognitive strategies is explained).
[xiii] Watt et al, n 7, 267.