THE MATHS PROBLEM CA. 2015: REFLECTIONS AND DIRECTIONS FROM LIFE SCIENCES

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BACKGROUND: WHAT THE PAPERS SAY

In recent years there have been concerning headlines in the media that speak to the pervasiveness of the *maths problem* through Australian science, technology and mathematics (STEM) education from primary to tertiary. The Australian Financial Review referred to ‘Australia’s maths crisis’ (Mather, 2015) in reference to the 15-year trend of Australian school students' continuing poor performance in international testing. This trend aligns with the ‘20-year decline in science and maths education’ (Phillips, 2015). The Conversation tells us ‘Aspiring teachers [are] abandoning HSC maths’ (Smith, 2015) so that those intending to teach at school are not gaining the basics during their own school education and so are likely to struggle with gaining adequate mathematics expertise to be able to teach it and there appears to be no incentive to study maths when ‘HSC maths: students studying advanced maths [are] stung with lower marks in ATAR’ (Bagshaw, 2015). The headline ‘Science graduates are not that hot at maths – but why?’ (Matthews, 2014) refers to a lack of sound numeracy skills our science graduates demonstrate. If nothing else, these headlines tell us that the *maths problem* as it manifests in tertiary life science is both complex and is of concern to the public at large.

MATHS IN CONTEXT: WHERE BIOLOGY MEETS MATHS

So where does that leave the higher education sector which relies on schools to provide the mathematics foundations for non-mathematics STEM disciplines, particularly in the Life Sciences, were the synergies between Mathematics and Biology seem less obvious students than the between, say, Mathematics and Physics? In Biology we require students to confidently transfer their numeracy skills, rather than their maths anxiety, to our discipline area and we require students to develop discipline-specific numeric sensitivities.

Given the complexity of both the Maths Problem and numeracy skills transfer, solutions to address these will need be complexity and to be as pervasive as the problem itself. Our work to date (e.g. Authors 2013) has been largely theoretical and focussed on characterising learning and teaching thresholds and discipline sensitivities in academic numeracy for biology students. Sensitivities are interesting and in the context of numeracy include: 1) the use of engineering notation rather strict scientific notation in life science e.g. physiology; and 2) the use of unit of measure prefixes in molecular biology and biochemistry. Students in general biology become proficient in switching between engineering notation and unit of measure prefixes. And of course in life sciences we use statistics. We need to provide numeracy support that has been contextualised for the discipline with the aim to develop sensitivities but the support materials ought to address issues such as maths anxiety and/or poor numeric confidence.

FUTURE DIRECTIONS: SHARABLE AND ADAPTABLE SOLUTIONS

We have now begun to storyboard an online diagnostic and learning analytics feedback system that can be repurposed, or "reinvented", by others. Learning analytics in adaptive systems such as SmartSparrow [https://www.smartsparrow.com/] or Numbas [http://www.numbas.org.uk/] will allow easy identification of threshold learning areas, or learning obstacles, which are where most students stuck. Critical to this initiative will be allow for students to access a level of learning analytics to track their progress with development of numeracy skills, discipline sensitivities and confidence.

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