THE IMPACT OF TECHNOLOGY IN STEM EDUCATION

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Importance of STEM to Australia's future

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- Important to our human and economic capital
- Help secure Australia's future prosperity
- Pillars on which Australia's productivity, living standards and community wellbeing are built
- Critical to making a successful transition to a knowledge economy
- Crucial to ensuring our success in a competitively global market

STEM skills

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‘An education in STEM…also fosters a range of generic and quantitative skills and ways of thinking that enable individuals to see and grasp opportunities. These capabilities – including deep knowledge of a subject, creativity, problem-solving, critical thinking and communication skills – are relevant to an increasingly wide range of occupations.’

(Professor Ian Chubb, Chief Scientist, *Science, Technology, Engineering and Mathematics: Australia’s Future*, 2014)

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Mathematical competence has been identified by the European Parliament and the Council of the European Union as one of the key competences necessary for personal fulfilment, active citizenship, social inclusion and employability in modern society.

(European Commission, Mathematics Education in Europe: Common Challenges and National Policies, 2011)

The State of STEM

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- In our region, India, China, Indonesia and Singapore all have national strategies (science, innovation, technology) to 2015 and beyond.
- Government commitment is fragmented across federal and state/territory governments
- Australia's STEM investments and policies suffer from a lack of coordination, misdirected effort, instability and duplication

STEM and education

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- Australia's performance in mathematical literacy has fallen
- Absolute performance in school-level scientific literacy in unchanged, but our relative performance has slipped
- 40% of Australia's Year 7 to Year 10 mathematics classes are taught without a qualified mathematics teacher
- Participation in science subjects in Australian schools has declined to lowest level in 20 years

Mathematics education in Australia

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- Student performance in numeracy in Years 3, 5, 7 and 9 has not lifted in the past 6 years (NAPLAN national reports)
- Year 12 advanced mathematics enrolments have dropped by 22% from 2000 to 2012.
- Undergraduate and postgraduate enrolments in mathematics and statistics have been stagnant for the last 3 years
- Australia's PhD graduation rate in the mathematical sciences is one of the lowest in the OECD and at half the OECD average.

(Source: AMSI, *Discipline Profile of the Mathematical Sciences*, 2014)

"If I had to pick any subject it wouldn't be maths"[1]: Student engagement and mathematics

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Broad range of factors that influence student engagement:

- Those from outside the classroom, including
  - Issues surrounding the nature of adolescence
  - Family and peers
- Those within the classroom, including
  - Relevance of curriculum to their lives outside school
  - Traditional individualised work in mathematics classrooms discourage meaning, engagement and understanding.
- Core influence
  - Teachers and teaching and learning practices

[1] Catherine Attard, 'If I could pick any subject, it wouldn't be maths', Mathematics Education Research Journal, 2013, 25: 569-587.

Improving mathematics education

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How do we improve teaching in mathematics education?

- Actively address any resistance to enlivening the curriculum
  - Investment in teacher education
  - In-service professional development
  - Upgrade of content and in pedagogical skills
- Use of more sophisticated learning materials that
  - Utilise new technologies, and
  - Capture concept understanding and modelling techniques
- Greater engagement with parents – to allow them to help
- Build a community of teachers within schools

Improving mathematics education II

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- Build strong STEM teaching at all levels
  - Discipline-based training
  - Continuing professional development in the discipline
  - Ongoing support for teachers to ensure lifelong learning in the discipline eg scholarships

Emerging Technologies

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- Integrated online, blended and hybrid learning and collaborative learning models
- The ubiquitous nature of social media
- Learning analytics and data driven learning and assessment
- Shift in trend from students as consumers to students as creators with creativity illustrated by:
    - growth of user-generated videos;
    - crowdfunded projects; and
    - maker communities.
- Agile start-up models: e.g. use of technology as a catalyst for promoting a culture of innovation
- Evolution of online learning, e.g. MOOCS

Source: Johnson, L., Becker, A.S., Estrada, V., Freeman, A.,. (2014). *NMC Horizon Report: 2014 Higher Education Edition*. Austin, Texas: The New media Consortium

The role of technology

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Opportunities:

- Increase student engagement in STEM education
- Shift from learning by rote and memorisation to a more problem-solving approach
- Offers students the opportunity to develop creativity, to think in innovative ways

Challenges:

- Can be time and resource intensive – training required along with ongoing professional development
- Fast pace of technological change

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It’s the way in which technology is used that is crucial

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The essence of learning at UWS is…

…Engaging on campus experiences

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…synchronous and asynchronous online

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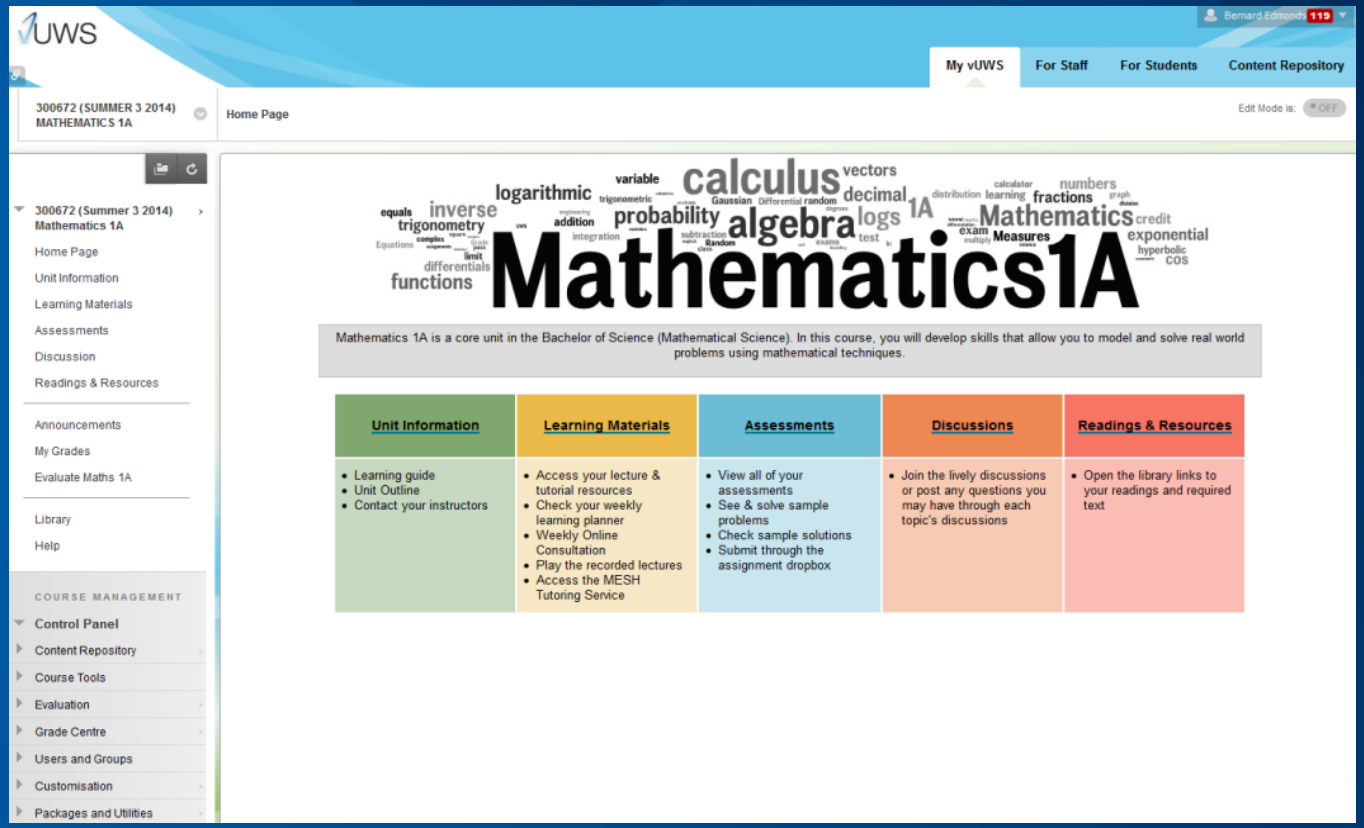

…integrated community engagement

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School of Computing, Engineering and Mathematics

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- Deploy technology in teaching mathematics and statistics in different ways:
  - Multi-campus support of traditional lectures
  - MESH support
  - Online supporting materials for regular units
  - Use technology in classroom to skip the religious part of the course, and so encourage students to be more creativity
  - Online synchronous delivery for external students

School of Science and Health

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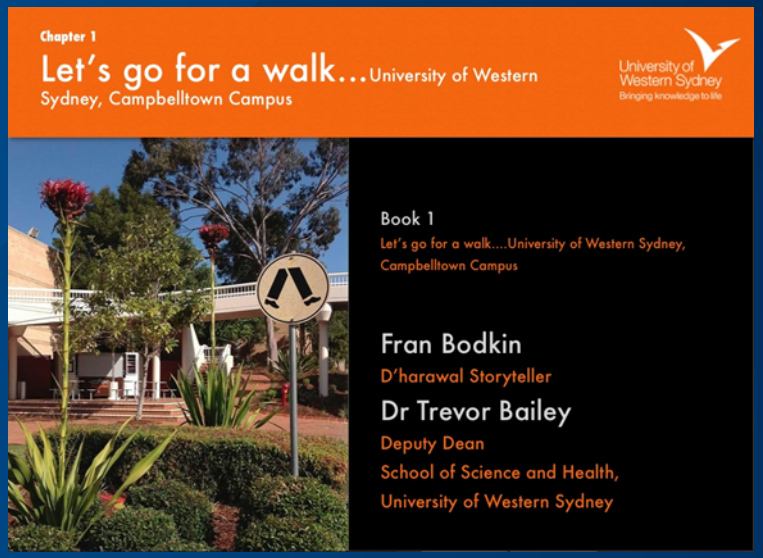
iBook: Mangamai'bangawarra: Indigenous Science

- Interactive resources
- Videos and iBooks
- Self-paced learning environment
- Online learning



Conclusion

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- STEM is critical to Australia's future prosperity
- Need to take advantage of the massive strides in technology and opportunities for blended learning
- Most crucially, technology needs to be used creatively and innovatively in STEM teaching