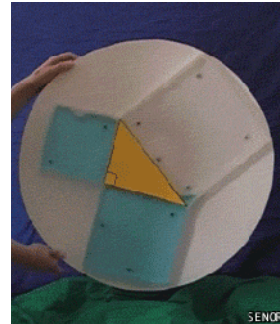



Encouraging High School STEM Study in Preparation for Tertiary Studies in Science and Engineering

Scott Smith

Dean of Engineering
Southern Cross University
Lismore, NSW, Australia
scott.smith@scu.edu.au



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Scope

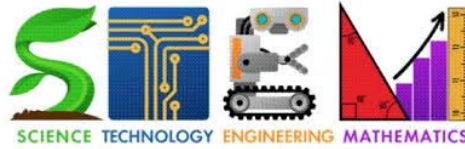
- STEM definition
- Education trends
- Education strategies
- Concluding remarks



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STEM

- Science
- Technology
- Engineering
- Mathematics



(apply maths and science, think critically, engineering approach to solve real-world problems)

STEAM

- Arts
- (encourage creative solutions)

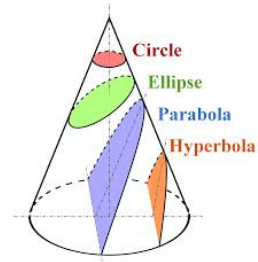
Reminisce

Think back to your high schools days:

- Did you like learning maths (physics, chemistry)?
- Why?
- Did you find maths (physics, chemistry) easy or difficult?
- Why?
- Were your class notes conducive to learning?
- Did your teacher effectively facilitate/inspire learning?

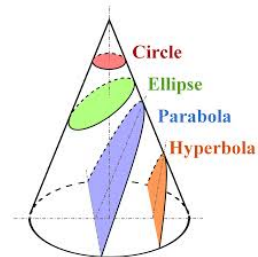


HOW TO CREATE AN ELLIPSE



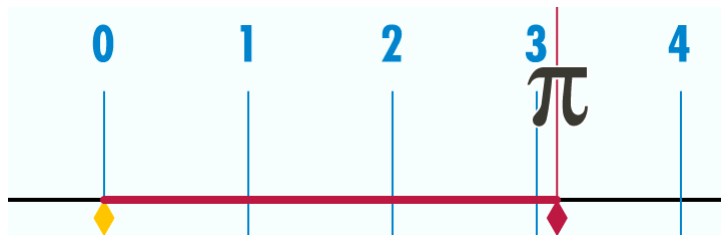
$$\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$$

HOW TO CREATE A PARABOLA



$$y = ax^2 + bx + c$$

What is π ?



Mathematical constant

3.14159265358979323846264338327950288419716.....

Some Statistics

- 50% economic growth in US: Scientific and technological advances in US
- 65% growth in economy per capita in Australia 1964-2005, STEM related
- 75% fastest growing occupations requires STEM skills and knowledge

Some Statistics

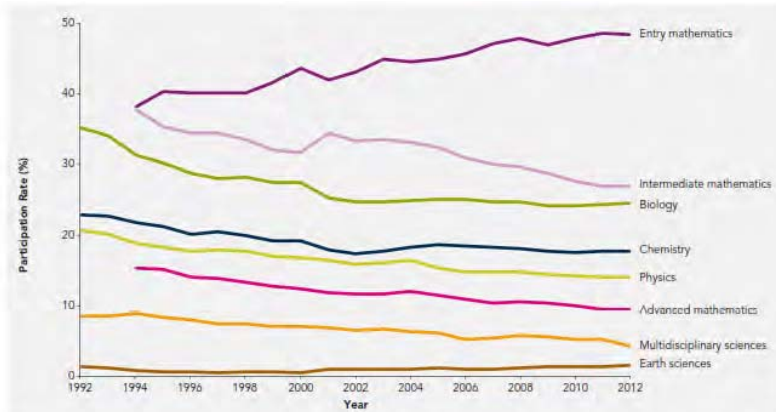
- 25%: Australians capable of basic maths (e.g. counting) (PC)
- 18%: Australian workforce has STEM skills
- 15% (2012): Year 12 students studying STEM subjects to equip them for university engineering
- 10% (2013): High school students studied advanced maths (6.6% girls, 13.2% boys)
- 34% (over past 18 years): Drop in high school intermediate and advanced maths participation
- 1.5% (NSW): Year 12 girls study trio of advanced maths, physics, chemistry
- 30%: Women enrolment in university mathematics related courses

Some Statistics

- 40%: Year 7 to 10 maths classes are taught without a qualified mathematics teacher (OCS 2015)
- 36% (2001-2013): Decline in computer science students
- 15%: Female computer science graduates
- 2-3 years: Australia behind Japanese, South Korean, Finnish students in maths at 15 years of age: Programme for International Student Assessment (PISA)
- 33 out of 33: OECD nations rate of Australian business collaboration with higher education
- 11%: Proportion of tertiary students with first degrees in STEM
- 30%: Fail to complete an engineering degree (EA 2014)

Participation Rates

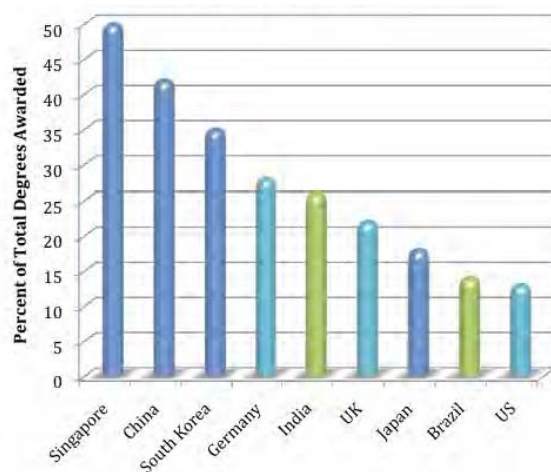
- Year 12 Maths and Science participation rates (1992 – 2012)
- Mathematics, science not compulsory in years 11, 12: NSW (since 2001, maths), Victoria, WA



Ai Group (2015)

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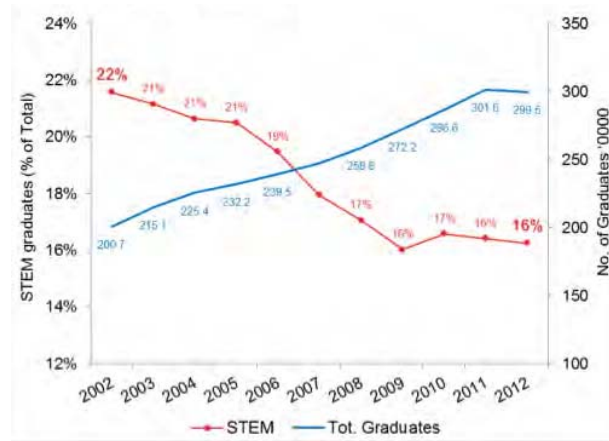
University STEM Degrees



Ai Group (2015)

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Australian STEM Graduates



Ai Group (2015)

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Why the Decline?

- Curriculum: content, relevancy (to real world)
- Science, maths not compulsory.....should they be compulsory?
- Teachers: inspirational/passionate versus not teaching in own area.....expertise of teachers graduating university
- Careers advisors: money/prestige in other areas (e.g. business)....high marks = medicine (for example)
- Maximise HSC marks taking non STEM subjects (including entry maths)
- STEM does not promote itself well

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On the Agenda

“Industry groups, professional bodies and the chief scientist have all called for a national STEM strategy that will encourage children’s interest in engineering and ultimately ensure a vibrant and economic future for this country.” (EA 2014)

Office of the Chief Scientist

- 2014 report *Science, Technology, Engineering and Maths: Australia's Future*.
- A call for Aus. to increase STEM competitiveness.

US: National Science and Technology Council

- Chair, President of the USA

Prime Minister’s Science Engineering and Innovation Council (PMSEIC)...proposed



Australian Government
Department of Education and Training

2015, \$12 million

Restoring the Focus on STEM in School Initiative

1. Providing innovative mathematics curriculum resources, focusing on inquiry-led teaching. (\$7.4million)
2. Supporting the introduction of computer coding, leading to greater exposure to computational thinking....expanding the pool of ICT-skilled workers. (\$3.5million)



Australian Government
Department of Education and Training

3. An innovative approach to education based on the United States 'Pathways in Technology Early College High School' (P-TECH) model. (\$0.5million)
4. Summer schools for STEM students, to increase the number of girls and disadvantaged students attending — including Indigenous students and regional and remote areas. (\$0.6million)

\$5 million allocated in 2014-15 Budget for Primary Connections and Science by Doing programmes.

Olympiad Programs

AUSTRALIAN MATHEMATICS TRUST



- Australian Mathematics Trust
- Australian Science Innovations

- Mathematics (since 1978)
- Informatics
- Science (85% employed in science related fields)



Action

Engineers Australia

- D. Corbett (April 2014) *Where is Australia's national STEM strategy?*, Engineers Australia.
- EngQuest. National primary school outreach program to equip teachers with resources to teach STEM
- STEM Education Conference 2014
- Newcastle Division: Teacher training packages

Re-Engineering Australia (REA) F1 In Schools, SUBS In Schools



RE-ENGINEERING AUSTRALIA
FOUNDATION



ENGINEERS
AUSTRALIA

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Action



- Google Australia \$1million to encourage STEM in high schools (July 2015)
- AIME (Australian indigenous Mentoring Experience), incorporate STEM content into Year 7, 8 curriculum. 4,000 indigenous students by 2018.
- FIRST Robotics Australia: FIRST LEGO League and FIRST Robotics programs into 150 new schools. Reach >1,500 students among low-SES areas, regional and other under-represented groups.
- Engineers Without Borders Australia: Expand "Regioneering Roadshow". Hands-on, STEM and computer science-focused training to 5,000 young people.



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STELR Program

STELR: Science and Technology Education Leveraging Relevance
Australian Academy of Technological Sciences and Engineering
(ATSE)

> 400 schools mainly in Australia (also in NZ and Asia)

> 30,000 students influenced

Years 9, 10 scheme: hands-on, inquiry-based, in-curriculum
program (extended to years 11, 12)

Theme: global warming + renewable energy...to show relevance
of STEM to life



iSME

- iSME = Inspiring Science and Mathematics Education
- \$1.6million program
- 2014: 2-year grant, \$996K Australian Maths and Science Partnerships Program Competitive Grant Round
- Years 7-10
- Development of multidisciplinary classroom modules...web-based
- Southern Cross University (lead), University of Wollongong, Charles Darwin University, ATSE

Inspiring Girls in STEM

Curious Minds (Aus. Mathematics Trust, Aus. Science Innovations)

- Years 8, 9, 10
- Match each student with female mentor
- 6 month program (2 residential camps + mentoring program)
- Canberra



Inspiring Girls in STEM: Universities

Lunches, school visits, conferences, information and engagement events

Southern Cross University

- Women in Engineering



The University of New South Wales

- Women in Engineering



The University of Newcastle

- Women in Engineering

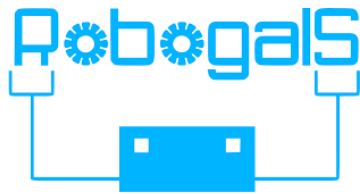
University of New England

- Women in Science, Technology, Engineering and Mathematics (WSTEM)



Robogals

An international movement ...encourage girls in STEM...uses hands-on robotics workshops...primary + secondary
> 8800 girls participated 2013-14 alone



Concluding Remarks

- Learning (STEM) can be fun....good habits early reinforces commitment
- Reinforce that success requires effort....no instant gratification
- Curriculum content (function of age/stage)
- Inspirational/motivational teaching. Technical competence
- Compulsory versus non-compulsory subjects
- Target primary to high school with differing strategies
- National body coordinating STEM effort
- The downward STEM spiral needs to change

Science and Engineering Challenge



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Thank you

scott.smith@scu.edu.au

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