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

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Scope

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

- Science
- Technology
- Engineering
- Mathematics

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

**STEAM**

- Arts

(encourage creative solutions)

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**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 $\pi$?

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**

- 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)
Australian STEM Graduates

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
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
- 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

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)
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 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

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**Action**

- Google Australia $1 million 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.
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
- $1.6 million 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 to 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

Thank you

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