Roadmap to STEM Education in Queensland

A strategic roadmap to support primary and secondary Science, Technology, Engineering and Mathematics (STEM) education in Queensland

6 November 2013

Facilitated by: Office of the Queensland Chief Scientist

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1. Introduction

The Honourable John-Paul Langbroek MP, Minister for Education, Training and Employment and the Honourable Ian Walker MP, Minister for Science, Information Technology, Innovation and the Arts, agree that our need for a high quality and steady supply of STEM talent for the future should be supported by the development of a high level STEM education strategy for Queensland.

On 29 October 2013, over 50 dedicated stakeholders (**Appendix 1**) from the Queensland and Australian Science, Technology, Engineering and Mathematics (**STEM**) education community came together to develop a strategic roadmap to assist and direct in delivering the best possible STEM education for Queenslanders.

People with experience, skills and education in STEM areas are important to help power the innovation needed for economic growth and general social advancement.

Similarly, a good standard of public scientific literacy is also important for making informed decisions in everyday life. Our education system plays a central role in inspiring, developing and training STEM talent.

We must develop strategies that will nurture the pipeline of STEM students and graduates to ensure we have sufficient talent to meet demand, retain STEM talent in the state and arrest the decline in the number of students studying STEM subjects at school.[1] To support this agenda we must also train (lifelong learning), support and empower the great teachers and educators of Queensland to facilitate the best learning experience possible for primary and secondary students in the state.

Strategic Focus

The ***Roadmap to STEM Education in Queensland*** provides a high level strategic roadmap to assist and direct a Team Queensland approach that delivers the best possible STEM education for all Queenslanders.

This roadmap is intended to align with and underpin the strategic plans of Queensland organisations that direct and support STEM education in the State.

Process

Workshop participants – who provided a diverse and experience-based perspective of the education challenges and opportunities for Queensland – were provided with a selection of background materials as pre-reading (**Appendix 2**). Some summary material is also provided as **Appendix 3**.

Following introductory remarks by Dr Jim Watterston, Director-General of the Department of Education, Training and Employment, participants worked through three strategy sessions:

- imagining our future, circa 2020, from a variety of perspectives (Section 2 and 3)
- describing our 'current reality' by way of a S.W.O.T. analysis (Section 4)
- focusing our efforts: priority actions needed to move from where we are now to where we desire to be (Section 5)

The outputs of these sessions are summarized in the sections which follow.

[1] Health of Queensland Science. Office of the Queensland Chief Scientist. The State of Queensland. 2013.

2. STEM Education in 2020: A day in the life of ….

A vision of a day in the life of Queenslanders in 2020, in a society that values and respects STEM education, a society that is STEM literate, and one in which all Queenslanders have the opportunity to reach their STEM potential and celebrate STEM successes.

…. a Year 9 Student: a connected, worldwide community of learners

…. a Science Teacher: facilitating student learning

…. a School Principal: flexibility and collaboration driving success

…. an Administrator: fostering pathways for engagement

…. a Year 9 Student: a connected, worldwide community of learners

Tom woke up this morning to the new alarm app he designed last week. After his shower he checks in to e-STEM (a site that has all the new, interesting and fun STEM news) and finds a story about a new innovation. He discusses the news story with the family over breakfast.

He is keen to get to school today to check in on the group's STEM project – he's already emailed Joe to check on any results that have come in overnight from some of the other teams working on the STEM project globally. You could already see some trends in the data. He can't wait to get to the school's STEM space to Skype with the STEM specialists at the university, so he can do some further analysis of these results.

Later the project team he's working with meet with Ms M to brainstorm some possible solutions to a problem encountered with the project. She coaches them through a problem solving process, they decide on an action, and put this practical solution into place. The team is looking forward to trialling this and reporting on the outcomes.

Tom blogs on the local council website to update the local community on the project's progress, the data collected so far, and future actions to be implemented. He receives comments from the project's industry partner, who provides some feedback on the project. They are keen for Tom to do an internship over the holidays.

Tom and Joe attend an online statistics tutorial in the afternoon to help them with analysis of the data they are collecting. Tom finds this helpful as he's struggled a little with this analysis. Later, Tom and Emily attend a face to face master class in experimental design to enhance their skills.

At home, Tom talks to his little sister Georgia – she's in year 5. She has been working on an inquiry about light and is curious about reflection and how it works. Tom and Georgia log onto the e-STEM space where she researches light and reflection and they upload the current data to the global STEM project.

As a family they watch the YouTube and TEDx clips on light that Georgia's teacher gave her in preparation for tomorrow's investigation.

A STEM student in 2020:

- is **connected**:
  - to their local community
  - to the worldwide STEM community
  - to a central e-STEM learning space
  - through a variety of technologies (all endorsed for full use in the classroom)
- is **partnered** with industry and universities (access is easy and embedded in the system)
- is **linked** to real world issues
- is **engaged** in inquiry pedagogy to build their knowledge and skills
- is **motivated** through autonomy, mastery through progression, contribution
- is living in a world that is increasingly **STEM aware**
- is **collecting data** from a variety of sources (local, state, national, global)
- is **developing choice** in their learning activities and learning environments
- is **building skills** to critically analyse and interrogate data and experiences.

…. a Science Teacher: facilitating student learning

Sam has just arrived back at the high school following his one year sabbatical in industry. The sabbatical gave Sam the opportunity to ensure his STEM skills are up to date, and of course, was a necessary requirement for him to retain his registration as a high school STEM teacher.

He starts the day meeting with his STEM colleagues from the regional clusters to chat about current STEM initiatives and skills. He then reads the STEM information bytes which are linked to classroom activities.

After a quick coffee, Sam attends his 'care group' where he mentors his students to advise them on their learning choices for the week. He suggests which lecture resources and 'experts' might help them obtain the information and learning experiences they need.

Sam then goes on an industry excursion with his STEM class to the 'cluster specialist laboratory' for their first laboratory session since they finalised the topics for their research projects. After the session, supervising the students and reconnecting with the STEM cluster specialists, Sam accompanies the students back to school for lunch. Sam enjoys a 'mentor' lunch with the pre-service teachers who are assisting with technology delivery for the team. He really appreciates his connection with the universities.

In the afternoon, Sam attends a tutoring session where he is delighted to see Mary, a 13 year old student who was recently appointed STEM captain of the school, being mentored by Professor Johnson at the STEM Institute. Sam reflects that five years ago he never would have imagined supporting an accelerated student to undertake an open ended project with such varied collaborations, particularly given he has very little knowledge himself of the project content. However, armed with access to state-of-the-art facilities and 'experts', and with a good understanding of inquiry-based investigations, Sam has been able to help Mary and her group achieve their goals.

Sam finally finishes the day conversing with Mary's mother. Mary's mum has contacted him to show her appreciation of his efforts in mentoring Mary through her term-long investigation. He reflects that this level of engagement from her parents is one reason why Mary has been such a successful student, "How can we get other parents to be this engaged?" he muses.

A science teacher in 2020:

- is a **mentor**, facilitating student learning through mentorship, co-learning and co-investigation
- is **mentored**
- is a key **contributor** to pre-service teacher training
- is **current** and is the recipient of frequent high quality professional development
- is **connected**, including to a cluster of STEM specialists.
- is **flexible**
- operates within a **student centred approach**
- is **valued**
- has ready **access** to resources, expertise and infrastructure, beyond the school.

…. a School Principal: flexibility and collaboration driving success

Ms Smith is principal at the local high school. The school's commitment to supporting STEM education has seen it named one of Queensland's STEM Centres of Excellence. Ms Smith starts her day with a quick coffee meeting with Sam, one of her committed team of STEM teachers. Sam has recently returned from a year's sabbatical in industry with Alpha Industries and Ms Smith is keen to capture what he has learned from the experience and have him share that knowledge with the STEM teaching team.

When she gets into the office, Ms Smith checks the email that has just come in from the school's STEM captain. In the email Mary has included a round-up of important current events and STEM news stories that she has identified on *e-STEM World*. Ms Smith will add some of them to her daily newsletter and Facebook post for the student cohort before school starts that morning. The fact that the stories include explicit links to the curriculum in different fields and year levels makes them so valuable.

Later that morning, Ms Smith will accompany one of the senior science teachers and a group of Year 11 students to the local primary school, where the students take a group of grade 4 students through a robotics experiment they developed in the STEM Extension laboratory.

During the lunch break, Ms Smith has a quick Skype conversation with Dr Green from Alpha Industries. He will be undertaking an industry exchange into the school one day a week next term, to support the accelerated STEM programme. It's a great opportunity and will continue the great relationship Dr Green has established with the school following Sam's time with the company. Dr Green, Ms Smith and Sam have just finished co-writing a short paper on the Industry Exchange Programme for *e-STEM World*'s monthly education sector newsletter.

That afternoon, Ms Smith prepares for the Skype meeting she is hosting for interested parents that evening, to discuss the school's active learning programme, which is designed to provide access to learning that is tailored towards student's diverse learning needs.

A school principal in 2020:

- has **vision** and **understanding** of the direction of the school
- supports **flexible learning** structures within the school
- is engaged in **partnerships** with industry, later stages of the education sector and with the community
- is **supported by** well qualified and motivated **teachers** teaching their discipline and participating in trans-disciplinary teaching
- is an **enabler** of mentoring support and continual professional development for staff
- **encourages student engagement** - providing access to learning that is tailored towards their diverse learning needs
- supports explicit **teaching of discipline content knowledge** and skills in conjunction with project based and **inquiry based learning**.

…. an Administrator: fostering pathways for engagement

Anne is the Director of a STEM Partnership Brokering organisation. Her role includes promotion, funding, acting as the organisation's public face, and higher level political engagement. She is supported by a team of Partnership Brokers (industry and schools), and a comprehensive database of cluster specialist teachers, industry mentors, and members – volunteer STEM representatives, parents, and tertiary leaders from education and STEM.

Before work today, Anne drops her children off at the Science Club. Once at work she has a State-wide video conference with the team of Cluster Specialist STEM Teachers. They report on how their coaching activities are going in their cluster of Primary/Secondary schools. One cluster specialist reports how she arranged for an absent STEM teacher to be replaced by someone from another area, with a similar skill set. Another talks about their research partnership on maths pedagogy focussed on fractions and invites other clusters to be a part of the activity.

Later that morning, Anne meets with the STEM University and local industry representatives to sign a Memorandum of Understanding that will provide the Clusters with opportunities for internships for STEM teachers; extension experiences for modelling; and problem-solving real-world issues for middle school and senior school students.

In the afternoon, Anne takes part in a State-wide web conference (using the NBN) on the national/State collaborative program for young people focussed on de-mystification of STEM careers. This program focuses on the real jobs that STEM literacies lead. It seems to be working with middle school children as they can see that STEM education can open doors to an amazing variety of potential careers and is useful in everyday life in so many ways.

Last thing today, Anne meets with local indigenous elders to discuss their partnership to facilitate sharing the science knowledge of indigenous people with schools.

A science administrator in 2020:

- is **clustered** geographically
- feeds in to a **central STEM body**
- is creating **pathways for engagement**
- is **connecting** industry, community, educators, students, research sector
- is **celebrating** diverse success stories
- is **facilitating positive STEM experiences** for groups traditionally under-represented in STEM (women, indigenous, low SES)
- is helping the broader community become more **STEM aware**, **STEM literate** and **STEM tolerant**.

3. Vision

Creating opportunities for Queensland through science, education and innovation. OR

Growing a culture that values innovation and inquiry, to create opportunity for Queenslanders.

Following a session in which the workshop participants developed the unified vision statements above, the following key themes were also evident:

Inspiring Curiosity
Building Competitiveness
Creating Opportunity

4. STEM Education in Queensland today: key issues

Queensland has a strong tradition of support for, capability in, and commitment to science, technology, engineering and mathematics as economic drivers in the State. To this end, education has always underpinned our STEM successes.

The opportunity now exists to maintain the momentum generated by previous investment, activity and policy drivers, to review where our STEM journey has taken us, and to explore the opportunities for a STEM rich future in the State.

To this end, workshop participants developed a detailed list of the strengths, weaknesses, opportunities and threats (S.W.O.T.) in relation to primary and secondary STEM education in Queensland (**Appendix 4**). The list was then fine-tuned and the collective agreed upon the top five issues in relation to each category, as reported below.

Strengths

- Political, policy and strategic commitment
- Great teachers and great educators
- A focus on inquiry and experimental research
- Establishment of the Science Academies and school programs focussing on STEM
- Industry commitment and engagement.

Weaknesses

- Training and professional development of primary and secondary teachers
- STEM curriculum (competition, crowded, implementation, assessment, de-stability, practice, constant change)
- The value that the community places on STEM and education in general, and on teacher input, STEM teachers, and the promotion of STEM in particular

- Imbalance evident in the uneven distribution of STEM qualifications across all sectors, genders, indigenous/low SES/regional communities
- Poor resources to support practical (laboratory) studies.

Opportunities

- To change the view and become a world leader in STEM education
- To celebrate and profile our STEM successes through positive media coverage and raise awareness of STEM opportunities
- For collaboration, through co-ordination of existing STEM outreach and engagement programs and initiatives
- To engage with industry partners in the four pillars of the Queensland economy (construction, resources, tourism, agriculture)
- To equip people with transferrable skills (problem solving, data collection, critical thinking) through STEM education.

Threats

- The changing political environment
- A lack of community appreciation for STEM
- Failure to collaborate and embrace all opportunities
- A lack of understanding of the career opportunities (STEM and non-STEM careers) available to STEM graduates and a lack of employment security in STEM occupations
- Inconsistent connectivity (to technology)
- A new mindset in teacher education – generalists not specialists.

5. Our Strategic Priorities

- to assist and direct in delivering the best possible STEM education for all Queenslanders.

Workshop participants developed a detailed list of focussed strategic priorities (**Appendix 5**), to deliver on the Vision outlined in Section 3. The list was then honed and the collective agreed upon the top three strategic priorities, as reported below.

The priorities developed are deliberately high level and not linked to specific actions. They are intended to guide the development of more specific strategies for organisations supporting and directing STEM education in Queensland.

Strategy 1	Specific objective
Invest in evidence based STEM education	Provide specialised training and support for both primary and secondary teachers, including, for example, revisiting the excellent “Science Sparks” initiative Provide ongoing professional development for teachers and educators Foster professional learning communities Enhance resources and access to resources Embrace partnerships
Strategy 2	**Specific objective**
Establish an overarching STEM education body	Better co-ordinate STEM education and outreach at a State level Provide strategic advice to Government in relation to strategy and funding to support STEM education.
Strategy 3	**Specific objective**
Queensland Government to develop a five year plan for STEM education in the State, supported by adequate funding	Provide professional development for STEM teachers, including industry sabbaticals and post-graduate qualifications Incentivise local partnerships between education sectors and industry Encourage government employees in STEM professions to engage with schools Run a community engagement campaign to engage adults in STEM literacies Publicly and explicitly demonstrate that the Government values education (financially and culturally) as the foundation for growing a four pillar (agriculture, construction, resources and tourism) economy

6. Next Steps

The *Roadmap to STEM Education in Queensland* will be:

- A resource document to help guide the development of specific strategies, e.g. for STEM education in Queensland public schools, for STEM outreach activities by Queensland universities
- published on the website of the Office of the Queensland Chief Scientist and DETE
- distributed, promoted and driven by all participants of the Queensland STEM Education Workshop
- promoted to relevant peak bodies and industry associations for the STEM and education sectors
- supported by the Department of Science, Information Technology, Innovation and the Arts and the Department of Education, Training and Employment.

Evaluation

We are committed to reviewing this roadmap in twelve to 18 months, bringing key players together again to evaluate the:

- continued relevance of the roadmap
- progress against the Strategic Priorities
- success of the roadmap in contributing to the strategic priorities and direction of organisations that direct and support STEM education in the State
- continued alignment of the roadmap with the goals and objectives of the Queensland Government and key stakeholders.

Appendix 1 – STEM Education Workshop Attendees

Name	**Role**	**Organisation**
Prof. Peter Adams	Associate Dean (Academic), Faculty of Science	University of Queensland
Ms Elite Aloni	Social and Health Policy	Department of Premier and Cabinet
Ms Mandy Anderson	Director (Education)	Queensland Catholic Education Commission
Prof. Greg Anderson	Deputy Director	QIMR Berghofer Medical Research Institute
Ms. Jane Backhaus	Chair	Kids' STEM Convention Steering Committee
Ms Betty Baram	Manager, Curriculum	Department of Education, Training and Employment
Prof. John Bartlett	Executive Dean, Faculty of Science, Health, Education and Engineering	University of the Sunshine Coast (USC)
Dr Anne Brant	STEM Teacher in Residence	Queensland University of Technology
Ms Susan Burchill	Manager	CSIRO Education Brisbane
Dr Terri Burnet	Principal Education Officer (Science)	Department of Education, Training and Employment
Mr Mark Campling	Assistant Director-General	Department of Education, Training and Employment
Mr Theo Clark	Principal Project Officer	Queensland Studies Authority
Mr Peter Cooper		Queensland Association of Mathematics Teachers
Mr Andrew Dalgliesh	Manager, State Schooling Implementation	Department of Education, Training and Employment
Dr Peter Darben	SPARQ-ed Coordinator	The University of Queensland Diamantina Institute
Dr John Dungan	Director, Strategic Policy and Portfolio Relations	Department of Education, Training and Employment
Prof. Gordon Dunlop	Chair	Academy of Technological Sciences and Engineering (ATSE) Queensland
Ms Sophie Finemore	Premier's Education Advisor	Department of Premier and Cabinet
Ms Robyn Flexman	Project Officer	Queensland Minerals and Energy Academy

Dr Geoff Garrett	Queensland Chief Scientist	Department of Science, Information Technology, Innovation and the Arts
Ms Karen Gosney	HOD (Science)	Kelvin Grove State College
Mr Paul Gray		Emmaus College (Jimboomba)
Ms Tanya Haggarty	HOD (Science)	The Queensland Academy for Science, Mathematics and Technology (QASMT)
Ms Marian Heard	Manager	CSIRO Education
Ms Peta Jackson	President	Science Teachers Association of Queensland
Prof. Richard John	Dean (Learning and Teaching)	Griffith University
Dr Ewan Johnston		Office of the Chief Scientist (Commonwealth)
Ms Heidi Jones	Office of the Queensland Chief Scientist	Department of Science, Information Technology, Innovation and the Arts
Ms Kathryn Kayrooz	Principal	The Queensland Academy for Science, Mathematics and Technology (QASMT)
Ms Mary Kelly	Equity Director	Queensland University of Technology
Dr Deb Kember	Director, State Schooling Implementation	Department of Education, Training and Employment
Prof. Mike Keppell	Executive Director, Australian Digital Futures Institute (ADFI)	University of Southern Queensland (USQ)
Ms Tracey Lawson	Business Manager	Queensland Minerals and Energy Academy
Ms Simone Long	STEM Education Marketing Officer	Queensland University of Technology
Ms Louise Maddock	GSEA (Griffith Science Education Alliance) Coordinator	Griffith University
Mr Brian McEvoy	Principal Policy Officer	Queensland Health
Ms Karen McCord	Senior School Principal	Meridan State School
Ms Jacqueline Mergard	Secretary	Queensland Association of Mathematics Teachers
Prof. Suzanne Miller	Chief Executive Officer	Queensland Museum
Mr Brett Molloy	Director	Curriculum into the Classroom
Ms Sue Monteath	Education Officer	Curriculum into the Classroom

Mr Allen Moodley	Head of Science	Centenary State High School
Dr Sandra Nissen	Australian Curriculum Support - Teaching and Learning	Independent Schools Queensland
Prof. Pankaj Sah	Deputy Director	The Science of Learning Research Centre, UQ
Mr Alan Sampson	Assistant Regional Director - South East	Department of Education, Training and Employment
Mr Darren Shepherd	Principal	Toohey Forest Environmental Education Centre
Dr Nikki Sims-Chilton	Ministerial Advisor	Department of Science, Information Technology, Innovation and the Arts
Mr Tim Smith		Mt Alvernia College
Mr Greg Thurlow	A/Director, Tertiary Education and Training	Department of Education, Training and Employment
Dr Debra Venables	Office of the Queensland Chief Scientist	Department of Science, Information Technology, Innovation and the Arts
Mr Reeve Waugh	Professional Development Consultant, RUN Digital Classroom	University of Southern Queensland (USQ)
Ms Alexandra Winter	Project Manager	Skills Queensland

Appendix 2 – Workshop pre-reading

1: *Health of Queensland Science.* Office of the Queensland Chief Scientist. Queensland Government. May 2013.

http://www.chiefscientist.qld.gov.au/assets/Health-of-Qld-Science-12-July-2013.pdf

2: *Science, Technology, Engineering and Mathematics in the National Interest: A Strategic Approach*. Office of the Chief Scientist. Australian Government. July 2013.

http://www.chiefscientist.gov.au/wp-content/uploads/STEMstrategy290713FINALweb.pdf

3: *The STEM Crisis is a Myth.* Robert N Charette. IEEE Spectrum (http://spectrum.ieee.org/at-work/education/the-stem-crisis-is-a-myth). August 2013.

4: *Advancing STEM Education (Action Plan)*. Australian Academy of Technological Sciences and Engineering (ATSE). Released 10 October 2013.

http://www.atse.org.au/Documents/Publications/Media%20Releases/2013/stem-action-plan.pdf

Full report available via link in media release.

5: *Lifting our Science, Technology, Engineering and Maths (STEM) Skills.* The Australian Industry Group. March 2013

http://www.aigroup.com.au/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/LIVE_CONTENT/Publications/Reports/2013/Ai_Group_Skills_Survey_2012-STEM_FINAL_PRINTED.pdf

6: *Chalk one up for free school*. Judith Sloan. Contributing Economics Editor. The Australian. 15 October 2013.

http://www.theaustralian.com.au/opinion/columnists/chalk-one-up-for-free-school/story-fnbkvnk7-1226739866906

7: *Senior maths and science assessment report handed down.* Media Release. Minister for Education, Training and Employment. The Honourable John-Paul Langbroek.

http://statements.qld.gov.au/Statement/2013/10/14/senior-maths-and-science-assessment-report-handed-down

8: *HSC maths and science on the decline.* Media Release. University of Sydney. 21 October 2013.

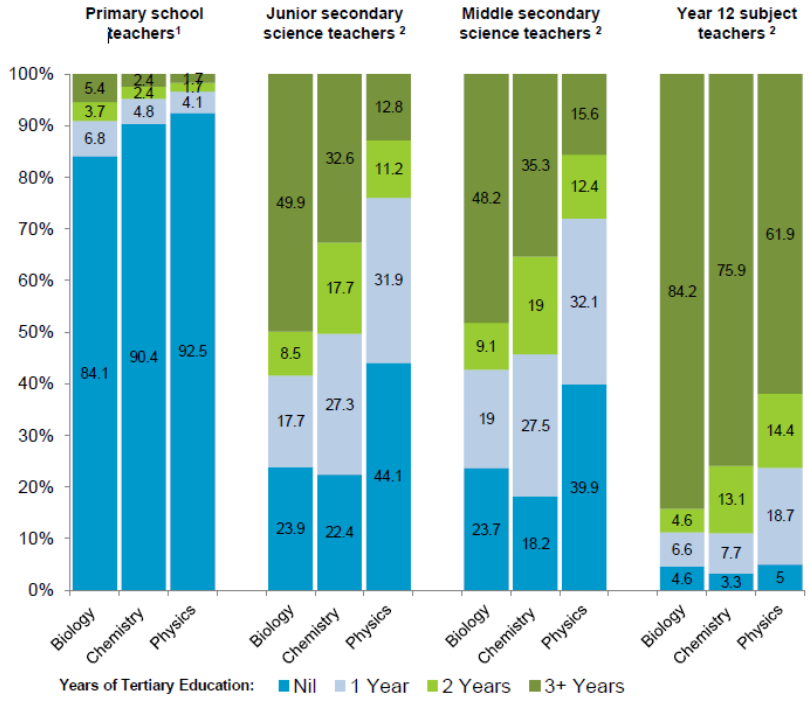
http://sydney.edu.au/news/84.html?newsstoryid=12516

Appendix 3 – Background: Queensland's STEM profile[2]

Workforce

- In 2011-12, more than 245,000 Queenslanders were clearly and directly employed in STEM-related occupations.[3]
- That is approximately 10.5 per cent of the total workforce – up from 8.5 per cent a decade ago.
- The general Queensland labour force grew at an average of 3.6 per cent per annum between 2001 and 2011, but STEM employment grew at more than twice this rate (7.7 per cent per annum on average).
- Despite this impressive growth, the proportion of people employed in STEM-related occupations in Queensland is still below the national average (11.1 per cent).

Figure 1: STEM Teaching in Australia[4, 5]



STEM Teaching and enrolments

- In primary schools - where our students are below the national average in science - most Australian teachers do not have a tertiary background in the major traditional sciences.
- More than one third of junior and middle secondary science teachers have no substantial tertiary physics education.

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[2] Health of Queensland Science. Office of the Queensland Chief Scientist. The State of Queensland. 2013.

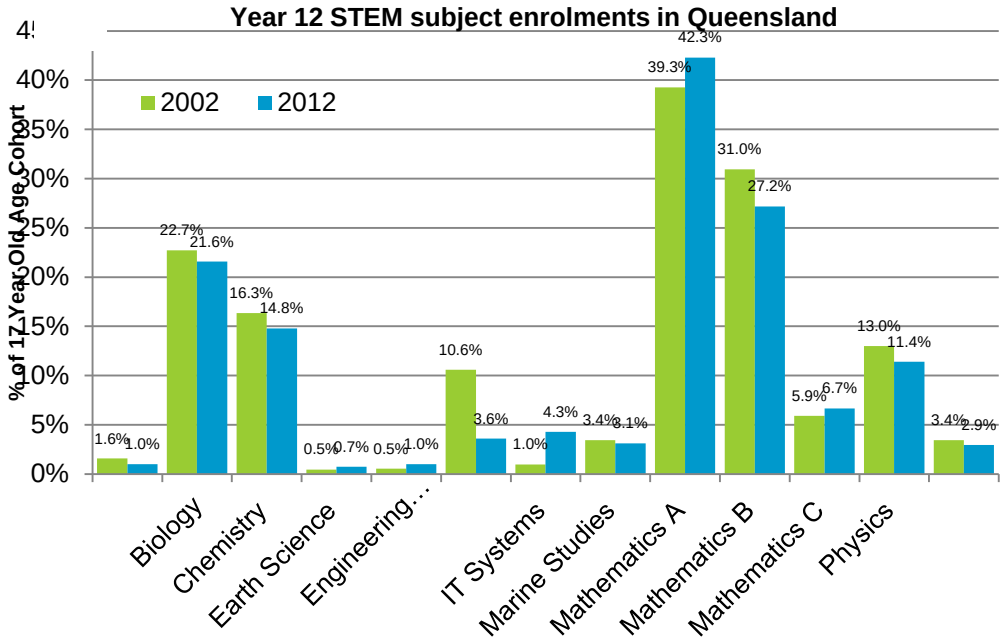
[3] ABS Labour Force, Australia Catalogue # 6202.0.

[4] Staff in Australia's Schools 2010: Main Report on the Survey. Australian Council for Educational Research (2011).

[5] Who's Teaching Science? Meeting the demand for qualified science teachers in Australian secondary schools. Australian Council of Deans of Science (2005).

- At Year 12, most science subjects are taught by dedicated subject teachers. Most of these specialised teachers have educational attainment in their teaching areas. However, a significant fraction are teaching science subjects with little (one or two years) or no tertiary science subject training – one quarter in chemistry and more than one third in physics.
- The proportion of all Queensland 17-year-olds studying the major science subjects in Year 12 has been in decline since the early 1990s –a pattern which has continued over the past decade.

Figure 2. Year 12 STEM subject enrolments in Queensland[6]



[6] Queensland Studies Authority, *http://www.qsa.qld.edu.au/617.html.*

Appendix 4 – Detailed List of workshop S.W.O.T. Analysis

Strengths

Top 5:

Political / policy / strategic commitment

Great teachers and educators

Focus on inquiry / research experimental

Science academies / school programs focussing on STEM

Industry commitment

Other:

- Investment in STEM facilities
- National curriculum – consistency of program delivery
- Scholarships to support pathways into STEM fields for under-represented groups
- Rich/diverse environment
- Geographical proximity to Asia
- Collaborative approach and desire to improve/focus on future of STEM education
- Rapid progress in meeting targets, e.g. Year 12 completion
- Recognition by those engaged in the area that STEM matters
- Access to technology one-on-one
- Outreach programs to engage
- World that is technologically engaged and dependent
- Dynamic rise in biomedical science in Queensland (research capacity)
- Human capacity – broader than just research

Weaknesses

Top 5:

1. Training – primary, secondary, ongoing and up-skilling professional development – demand/supply
2. Curriculum – competition, crowded, implementation, assessment, de-stability, practice, constant change
3. Value – in STEM and education, and teacher input and STEM teachers generally, culture promotion of STEM
4. Imbalance – uneven distribution of STEM qualifications across all sectors, gender, indigenous, low SES, metro/regional, lack of role models
5. Resources – can be poor in practical area

Other:

- Lack of STEM background in primary education
- Uneven distribution of STEM qualifications across all sectors
- Teaching unattractive (pay, conditions) to STEM professionals

- Community and media recognition of teaching as a career
- Political cycles don't permit long term thinking or implementation
- Lack of a unified direction/learning community
- Lack of STEM opportunities outside metro area and low SES – distance and cost
- Lack of community value for STEM skills and careers
- Gender, Indigenous and low SES imbalance
- Crowded curriculum and high stakes assessment – teachers overloaded
- Lack of leadership / promotion of STEM from education administration and authority
- Lack of STEM role models (gender, low SES, indigenous)
- Lack of up to date resources to teach STEM in school
- Not enough STEM teachers trained including primary training and ongoing targeted professional development
- Limited training and resources in primary
- No engineering in schools
- Not enough post-graduate study
- Not enough focus on demand and meeting it
- Poor perception and recognition of teacher role
- Lack of value for STEM teaching
- Poor culture (e.g. sports captain, music captain but no STEM captain) (free transport to sporting events but not to STEM events)
- People making the decisions aren't in the classroom – teachers are the experts, consult them
- Lack of common practice
- Operating in a system of silos: unis – secondary – primary – jurisdiction
- Constant change = lack of certainty = destability political cycles
- Explicit teaching is a "dirty" word
- No time to reflect on practices
- Balance between core skills, technology and resources
- Resource poor in practical areas
- Remuneration for STEM careers and its correlation to enrolments

Opportunities

Top 5:

1. Change the view – Become a world leader in STEM education.
2. Celebrate and profile our STEM successes through positive media coverage and as a result raise awareness of opportunities within STEM
3. Collaboration through co-ordination of existing programs/initiatives. Learn from other success stories. (e.g. collaborations, co-ordinated outreach initiatives etc)
4. Engage in industry through 4 pillars to support education - construction, resources, tourism, agriculture
5. STEM study equipping people with transferrable skills (i.e. problem solving, data collection, critical thinking)

Other:

- Raising awareness
- Wealthier society
- Fulfilment
  - Personal
  - Community
  - Global
  - Career
- Collaboration and connection
- Learn from experiences with others
- Celebrate successes
- Innovation in development of new technologies; opportunity for a range of STEM careers/research and from this economic benefits
- Engagement in STEM should break the cycle of mediocrity
- Change the view of education in Queensland. Set expectations high
- Celebrate and profile our successes in STEM through positive media coverage
- Engage with industry representatives from the four pillars to support educational initiatives
- Coordination of existing outreach programs state-wide
- Review of programs to negate replication of outreach and ensure coverage of curriculum outcomes
- Knowledge of STEM setting you up for pathways beyond STEM fields
- Tertiary education institutions in Queensland working together on this
- Selling the story that STEM skills and knowledge set you up for career pathways beyond STEM field
- Good community support for value of STEM education
- STE as hobbies
- Focus on early years to help reach decisions later
- Become world leaders in STEM education

Threats

Top 6:

1. Political Environment
2. Lack of Community Appreciation
3. Failure to collaborate and embrace all opportunities
4. Careers (both STEM and non-STEM) – lack of understanding of STEM opportunities and lack of employment security
5. Lack of consistent connectivity (to technology)
6. New mindset in teacher education

Other:

- Short- term perspectives from Government
- Lack of interest in STEM by Government
- Political apathy
- Short length of Political Cycle (not enough time to deploy strategy)
- Cultural disconnect to STEM
- Lack of community appreciation of STEM
- Failure to embrace all opportunities
- States and Commonwealth failing to collaborate on incentivising partnerships and cross-sectoral activity
- Insecure employment for specialist STEM career
- A lack of understanding of STEM related non-specialist careers
- Science-related global incident/disaster – negative feedback look with respect to STEM
- Failing to build depth and density of STEM understanding beyond consumerism of science/technology
- Further decline in interest from young people
- No improvement in pre-service teacher education
- The way the subject is assessed in school (Primary to Secondary): e.g. final exams – teaching is driven by final assessments, composition of school students not factored in (e.g. schools with a high concentration of behaviour issues / ESL students etc)
- Increased competition between schools (head hunting of teachers)
- Increased competition between schools and industry (qualifications going to work for industry – especially given the STEM focus of the four pillars)
- Motivations for STEM policy
  - Assessment
  - What does it measure?
  - Driven by politics
- Correlation between poverty and performance
- ‘Courier Mail’ story (‘tables’ – "sportification" of STEM via ‘scoreboard’)

Appendix 5 – Detailed List of focussed priority actions

1. Investment in STEM education (evidence based) through:
    a. Specialised training for both primary & secondary teachers
    b. Ongoing professional development
    c. Fostering professional learning communities
    d. Enhancing resources & access to resources
    e. Embracing Partnerships
2. Overarching STEM body:
    a. Co-ordinates at a State level
    b. Strategic advice re: funding
3. State Government to make a 5-10 year plan with FUNDING to:
    a. Provide professional development for STEM teachers;
    b. Incentivise local partnerships between education sectors & industry;
    c. Encourage government employees in STEM professions to engage with schools (compare with Scientists in Schools)
    d. Run a community engagement campaign (possibly via V.E.T) to engage adults in STEM literacies
4. Publically and explicitly value education (financially and culturally) as the foundation of the four pillars.

Other recommendations:

- Take a whole-of-government approach to STEM policy by establishing a State advisory body akin to PMSEIC
- Establish STEM awards
- STEM is the foundation for the four pillars, underpinning employment, growth, prosperity and innovation into the future.
- Queensland is a centre of excellence in STEM education (teaching, students, facilities)
- OQCS to co-ordinate and promote STEM outreach and engagement activities across the State.
- Civic Scientific Literacy:
    - Teachers – increase capabilities, enabling, empowering & rewarding.
      Ongoing professional development, P.G. study options, STEM specialist at primary
      rewards! Recognition through scholarships.
    - Cultural Change
        - Around perceptions of STEM studies/careers
        - Identifying reasons for STEM aversion in students
            - When/why does it happen?
            - How do we change it? Influence the influencers!
            - Community perception
        - Facilitate Partnerships/collaborations – schools, community, industry, tertiary

    - within schools
    - within clusters
- Targeted funded research studies on how to do the above i.e. evidence base
- Provide time and university training across the education spectrum to engage with STEM and ongoing in-situ professional Learning
- Lab technician time and resources to support Primary School teachers
- Use media strategies/media campaigns to create a positive persuasive presence of STEM value in the public mind by celebrating ROLE MODELS within research or industrial leaders, demystifying STEM careers & transferability of STEM skills.
- STEM FOUNDATION (Stakeholders have a say)
  - Enables positive media around great practices happening to increase societal values
  - Co-ordinates what is happening now across sectors & pulls best practice together
  - Influences Teacher practice/training
- Successful Evidence based practice (including ongoing evaluation) and evidence based decision making
  - Which sets the direction for sustained impact (take out the politics)
- Agreed message that drives the STEM agenda (We're all in this together →personal responsibility) Grass roots support
- Growing a culture that values STEM & STEM Education by:
  - Leadership at all levels of government and private industry taking ownership of the STEM agenda
  - Consultation and engagement with practitioners and professionals in the field.
- The future of our state relies on the STEM capabilities of people who reside here. Your leadership to enable collaboration between industry, higher education and schools to work towards a common goal is required, as well as:
  - Funding for on-going mentoring and Professional Development to ensure retention and development of quality teachers
  - Encourage the expectation that STEM professionals engage, and provide input, into primary, secondary and community education programs – impetus, design and delivery at local level working off government leadership to ensure consistent approach
- Teacher capacity:
  - Primary (specialised, lab support, target funding and up skilling)
  - Secondary (professional development and up skilling)
  - Simplifying
- Community
  - Career awareness – standard – skills for yet to exist – nonstandard
  - Lifelong scientific literacy program
- Media campaign