

Every student succeeding

State Schools Strategy 2016–2020



Science, technology, engineering and mathematics (STEM)

Successful learners



Science, technology, engineering and mathematics (STEM) are widely recognised to be at the forefront of global change and innovation. Access to world-class STEM education is vital for Queensland students to develop the skills necessary for the careers of the future. As part of a global community, Queensland students face the challenge of remaining competitive in the international market and becoming the next generation of STEM leaders and innovators.

All Queensland students deserve access to quality STEM learning experiences and schools, leadership teams and teachers are tasked with providing a world-class education to engage and inspire students. To achieve this, we must build teacher capability and confidence in the teaching of STEM subjects and provide opportunities for professional learning and growth.

Developing a world-class STEM education

World-class STEM education is vital to facilitate student engagement, participation and successful transition to a career in the STEM economy.¹ Queensland schools are tasked with equipping students with STEM knowledge, along with skills and abilities to discern how to apply this knowledge within evolving contemporary contexts. STEM education in Queensland schools involves teaching, assessing and reporting on the Australian Curriculum in **Science**, **Mathematics** and **Technologies** to all students in Prep to Year 10. Across the year levels, teachers develop ways to use STEM education as a platform for developing critical and creative thinking and the ability to innovate.

We know that students' interest in school science is likely to increase when it is related to a real-world context.³ Science and mathematics is engaging when it makes connections to students' everyday lives and when they have an opportunity to experience physical phenomena first-hand.⁴ For example, digital technology enables schools in different locations to undertake inquiry-based investigations and share research results with their peers, connecting local and global issues in a vibrant and personal way. Engineering contexts can provide particularly engaging and relevant focuses for many students learning STEM.

We need a reliable pipeline of specialist STEM skills; but we also need informed workers, users and consumers who have the curiosity and imagination to be part of the broader STEM economy. This must be underpinned by a lifetime engagement for all Australians with STEM, beginning in childhood and constantly renewed as knowledge and technologies expand.²

Engaging all students in STEM learning involves:

- varying the breadth and depth of content to challenge and extend and to revisit concepts
- providing opportunities to apply knowledge and skills in new contexts.

Teachers need to engage with research about STEM issues to better understand the impact of their practices on student learning and performance. A culture that values the importance of STEM and a whole-school approach to improving STEM achievement develops consistent expectations about the teaching and learning of science, technologies and mathematics, and a shared understanding of effective practice.

¹ Office of the Chief Scientist *STEM: Australia's Future*, September 2014, p 21

² Ibid, p 21

³ Tytler, R., Symington, D., & Smith, C. 2011. *A curriculum innovation framework for science, technology and mathematics education*. Research in science education, 41(1), pp 19-38.

⁴ Global Learning and Observations to Benefit the Environment (GLOBE) 2015 www.globe.gov

Engaging and inspiring all students

Queensland students and all Queenslanders benefit from economic activity supported by STEM capabilities. For example, advanced mathematics underpins mobile phone and wireless internet networks that are integral to modern life. New technologies and science are at the frontier of Australia's agricultural boom and will be part of adapting to climate change and helping Australians develop new vaccines and engineering innovations. Queenslanders will benefit from advanced physical and mathematical sciences at an economic advantage to Australia of \$292 billion a year.⁵

Internationally, evidence shows that Queensland primary and junior secondary students perform significantly below those of other states and our Asian neighbours in STEM subjects. While there are improvements in senior secondary, fewer Queensland students achieve at the highest level compared to Singapore and Shanghai, China.⁶ Current data further highlights an underrepresentation of girls, Aboriginal and Torres Strait Islander students and those from disadvantaged backgrounds studying and achieving in STEM disciplines. The need to increase student performance and the number of students continuing on to further education in STEM-related fields is a priority to deliver the benefits to both individuals and the wider Queensland economy.

STEM capabilities enable young people to apply and adapt new technologies, engineer applications and create solutions for social and environmental challenges at the local and global level. Engaging and relevant learning environments, which elicit real world problem solving, are vital to preparing our students as innovators and capable, confident citizens shaping Australia's future.⁷

Increasing teacher capability

Teacher capability and confidence are key drivers in ensuring student engagement and participation in STEM. Inspiring and effective teaching practices and collaboration between teachers can help create exciting and innovative pedagogies that engage students, lift their performance and generate enthusiasm for STEM careers.

While STEM learning can be applied in interdisciplinary projects on real-world issues, this requires the knowledge and skills specific to these separate disciplines. In order to effectively teach STEM subjects, teachers need to be equipped with the appropriate content knowledge, skills and capabilities. Some teachers are teaching STEM subjects without a background in the appropriate field.⁸ Schools have a responsibility to support these teachers to consolidate and extend their knowledge in order to become effective STEM practitioners and educators.

STEM teachers are to be encouraged to scale-up and spread innovation between schools, sharing effective STEM approaches at relevant conferences, via the STEM discussion list, and with partners. Across schools there is a need for explicit and differentiated teaching in STEM for all students, and a whole-school approach to directing support to different levels of student capability, including focused and intensive teaching for identified students.

⁵ Office of the Chief Scientist and the Australian Academy of Science *The importance of advanced physical and mathematical sciences to the Australian economy* March 2015 Australian Government. Canberra, Australia. Prepared by the Centre for International Economics (Measurements include only physics, chemistry, the earth sciences and mathematics).

⁶ Office of the Queensland Chief Scientist *Health of Queensland Science* 2013, p 14

⁷ Dr Michael Myers Re-Engineering Australia Foundation *Wake Up Australia – An open invitation to BHP Billiton* accessed 26 March 2015

⁸ Department of Industry and Science *Vision for a science nation. Responding to Science, Technology, Engineering and Mathematics: Australia's Future*. June 2015 Australian Government.

The way forward

A number of initiatives are already underway in order to support the transformation and effective delivery of STEM education in Queensland schools with the aim to:

- build teacher capability to transform STEM learning
- achieve excellence in STEM learning
- increase student participation in STEM learning.

Developing world-class STEM education

- fast-tracking coding and robotics, as part of the Australian Curriculum: Digital Technologies in Queensland state schools from 2016
- establishing the [Queensland Coding Academy](#)
- engaging students in the Entrepreneurs of Tomorrow program providing opportunities for students to work with industry experts to develop business plans
- challenging students to solve real world coding problems through the Premier's Creating Queensland's future coding competition
- partnering with Queensland University of Technology (QUT) to develop a framework for regional clusters to build teacher capability and relationships with industry and universities.

Engaging and inspiring all students

- providing opportunities for underrepresented students to engage in STEM including the STEM Girl Power camp and targeted STEM programs such as those provided by CSIRO for Aboriginal and Torres Strait Islander students
- developing virtual STEM academies to extend the learning of high achieving STEM students in Years 5 to 9
- promoting the Entrepreneurs of Tomorrow initiative to reward innovation by Queensland students
- provide resources, news and events and career pathway information through the [STEM hub for parents and students](#) to inspire and engage students.

Increasing teacher capability

- employing STEM champions in all regions to provide support and mentorship
- providing access to professional development, resources and school leadership information to all state school teachers through the [STEM hub for schools](#). Non-specialist teachers of secondary science and mathematics may find the hub especially useful to develop content knowledge and pedagogical skills in these areas
- making [C2C materials for Science, Mathematics and Technologies](#) available to support implementation of the Australian Curriculum P–10 with comprehensive classroom planning resources including unit plans, lesson overviews, lesson plans, assessments and classroom resources. C2C materials for Technologies are in development
- offering Step into STEM Teaching Scholarships to support experienced professionals and university graduates seeking to transition to a teaching career in Queensland secondary state schools
- developing partnerships with industry to enable further opportunities for mentoring and coaching of teachers.