NSW GOVERNMENT Education

Education Council

STEM EDUCATION SUMMIT

SUMMARY OF KEY THEMES | SYDNEY, 5 NOVEMBER 2015

The STEM Education Summit, held in Sydney on 5 November 2015, was hosted by the NSW Minister for Education, Adrian Piccoli, on behalf of his Education Council colleagues. It was attended by just over 100 experts, thought leaders and STEM professionals from industry, government and education sectors.

The purpose of the Summit was to have a dynamic and open discussion about key issues and opportunities for STEM education in Australia, to inform the development of the national STEM school education strategy.

The afternoon was split into two sessions. The first session discussed the types of STEM skills young Australians need to thrive in the 21st century; the second session focused on how to increase participation and diversity in STEM education. The Summit discussion was moderated by ABC Radio National presenter Natasha Mitchell. Conversation starters for key themes of the day were: Ian Chubb, Chief Scientist of Australia; Alan Finkel, Chancellor of Monash University and incoming Chief Scientist; Kate Burleigh, Managing Director, Intel; Mark Butler, Head Teacher Science, Gosford High School; Veena Sahajwalla, Director, SMaRT@UNSW; and Sam Bucolo, Professor of Design and Innovation UTS.

The Summit covered a great many issues in STEM education. Set out in this paper are the key themes which emerged from the conversation that are of particular importance for national strategy development. Over 40% of Summit participants also submitted further ideas and suggested areas for change online.

1. Skills for the 21st century

Business and industry representatives noted that STEM-related skills are highly valued in the workplace; however, there was also a general consensus that technical knowledge alone is not sufficient. Employers highly value employees having strong foundational STEM literacy, strong communication skills and design thinking skills. These types of skills help to ensure that people are flexible thinkers, problem-solvers and able to adapt to changing workplace needs. This is particularly important given many workplaces are expected to be radically different in the near future, including through automation and the unpredictable nature of digital and technical disruptions.

Students need the basics in problem solving which maths, physics and chemistry provides. Computational thinking and technology literacy helps students acquire the problem-solving skills needed to effectively use and interpret large datasets, for example.

> *"We need to get the message out to people about the fact that many existing jobs require maths and technology skills."*

Participants discussed the growing employment opportunities in many STEM-related fields, particularly digital careers. And, in addition to this, noted that jobs outside of the traditional STEM occupations are increasingly requiring STEM-related skills. There is a strong role for both the VET and university sectors to support this skill development. The future of manufacturing in Australia, for example, is high end, value-added manufacturing which requires more advanced technical skills.

> *"Many people going into vocational occupations weren't inspired in maths and science in school, they discarded it, stepped away from it… but they need STEM skills."*

Mathematical literacy in particular was identified as a core capability needed across the community, not just for STEM university graduates.

> "WE'VE CREATED A CULTURE WHERE MANY PEOPLE ARE CONVINCED THAT IT'S QUITE ACCEPTABLE—IF NOT SOMETHING YOU CAN BE PROUD OF—TO SAY I WAS NEVER VERY GOOD AT MATHS."

2. Addressing the STEM image problem needs to be a national priority

STEM has an image problem in Australia, especially when it comes to girls. Maths and science in particular are seen as domains for 'geniuses', 'geeks' and 'nerds' and 'not for girls'. Young people are influenced by popular culture stereotypes of STEM jobs being male-dominated, or repetitive and socially-isolating (e.g. lab work or computer tech work) and by media reports about STEM workplaces being potentially hostile to women. Many young people, especially girls, self-select out of STEM because they don't identify with these stereotypes, lack the self-confidence to challenge themselves with STEM subjects, and are not aware of the many career doorways that STEM can open for them.

> *"If I could only ask industry for the one thing that they could do for school science, I would ask them to make the career opportunities crystal clear to students, to parents and to career counsellors."*

A common theme that emerged was the need to raise awareness about the opportunities and careers that will be available to students by studying maths and science. STEM literacy can open up a range of careers beyond the traditional STEM occupations. At the same time, there is a need to be upfront about the current career prospects for some graduates, for example in the physical sciences. Rethinking how careers advice was provided to students, and the important role that science and maths teachers have in this, was also raised.

There's an important role for parents too: "I can't tell you how many times a parent has said, 'it's okay Johnny, I was never good at maths so it doesn't really matter'."

The role of career mentors and role models for students, starting in primary school, also came up in Summit submissions.

3. Improving diversity and inclusion in STEM

A strong theme interwoven through many of the conversations was the importance of more diversity and inclusion in STEM. Issues around the gender disparity in STEM employment, and the underrepresentation of Aboriginal people, those from low socioeconomic status backgrounds and regional areas were also raised. Many participants pointed out that in order to increase STEM participation in poorly-engaged and underrepresented groups including girls and Aboriginal students we need to make STEM more relevant to them.

> *"The girls who give up on STEM-related studies are not doing that because they are not good at it; achievement and academic ability is certainly there."*

Young people get excited when using STEM to help solve problems of concern to them and their communities, and when learning is placed in a context that is relevant and engaging. There is a need to start early, to hone in on the natural curiosity of young children. Participants also noted that increasing online capacity is helping outreach to more people in regional areas.

Some Summit submissions highlighted the benefits of bilingual and culturally relevant STEM teaching, including for Aboriginal students.

4. Depth over breadth in the school curriculum

Many participants noted that school curricula are crowded and this can make it difficult for teachers to find the time for students to have a deep engagement with key content and concepts. This can affect students' attainment of foundational skills, and also limits the ability for teachers to help students develop deeper critical thinking and problem-solving skills.

> *"We skate over topics too quickly to give a helicopter view, in the interests of covering too much. We don't go deep enough into the topics and, when we do, the students think this is too hard."*

How we teach STEM plays a key role in attracting students to STEM and keeping them engaged. One participant described a four-stage process for mathematical literacy: to be able to take a problem, define it; translate it into a mathematical context; calculate it; then interpret the answer. However, the design of maths education and assessments tend to focus primarily on the third element—calculation—thereby losing sight of the creativity that should underpin mathematical learning. The importance of engaging the creative thinking of students in STEM more broadly was also discussed, along with the role of the humanities in partnership to STEM.

Many people argued that the traditional construct of classrooms and textbooks ("chalk and talk") needs to be refreshed. Technology is helping to change teaching and learning experiences, and this can provide teachers with new types of tools and resources that are based on relevant, real world examples to engage students and improve STEM learning outcomes.

Summit submissions included suggestions for the greater use of quality online content such as MOOCs (massive open online courses), and the creation of 'makerspaces' in secondary schools which facilitate project-based learning, collaboration and design thinking. Submissions also highlighted the need for teachers and school leaders to deeply value interfaculty collaboration and integrated learning.

5. "Computer science and coding is mathematics solidified"

Participants spoke about the importance of coding and the new national technology curriculum as a means of helping students develop deeper computational skills, use technology creatively to solve problems, and turning maths "from broccoli into chocolate" for students. Deep engagement with coding partnered with a solid foundation in maths and science helps students to develop higher order logical thinking and problem-solving skills.

> *"When students do coding, they are learning analysis, they are learning rigour, they are learning persistence, they are learning to deal with failure, they are learning creativity, and they are learning the joy of discovery."*

Coding was described as the practical aspect of learning to think computationally, and it was noted that computational thinking skills can be incorporated holistically across the STEM curriculum.

Summit submissions included the suggestion of including gaming technology, such as the use of achievement 'digital badges', in the curriculum to engage and motivate students.

6. Teachers are the key

There was consensus that teachers are crucial to improving STEM participation, attainment and aspirations. While it was acknowledged that there are many high quality teaching graduates coming into the profession, participants discussed the need to attract more STEM-qualified and high-performing students into teaching, and some of the challenges associated with this.

There were differing views about entry standards for teaching qualifications, but broad agreement that pathways into the profession need to support people with a passion and talent for teaching. There was also discussion about the potential benefits of greater involvement by STEM content experts in pre-service teacher education courses.

> *"We need high standards for entry and pathways for people who could be good teachers but don't get there for all sorts of reasons that are not necessarily within their control."*

A strong theme was the importance of teachers, particularly in the primary years, having the confidence and content knowledge in STEM. Teachers need to be supported with time and resources, access to effective content-based professional development and opportunities to experience real world STEM environments.

"We're asking a huge number of things from teachers, and what they don't have—more than anything else—is the time to be all of the things that we're asking of them."

Summit submissions highlighted the range of existing teaching resources available, but also noted that some are not evidence-based or linked to the new national curriculum. One submission suggested greater use of apps that allow teachers to track and share professional learning experiences.

7. Role of universities in supporting better school STEM outcomes

Participants spoke about the importance of schools being seen as part of a broader education ecosystem, and the need for more seamless transition between the 'steps' in the education pipeline (preschool, primary school, high school and post-school education). Education sectors need to work in partnership to improve STEM education outcomes.

There was discussion in particular about the influence of the higher education sector on young people's choices around STEM, including subject choices in high school.

Participants discussed some of the apparent perverse outcomes of the competitive ATAR entry system, which can drive students away from studying more challenging subjects in Year 12 even where it would directly benefit their post-school study and career aspirations. Acknowledgement was given to the wide range of subject choices now available to students and the complexity of the evidence about what drives students' subject choices.

Participants debated the potential benefits (and drawbacks) of universities returning to setting subject pre-requisites as a way of increasing secondary students' participation in more challenging STEM subjects. Discussion also considered the responsibilities of universities in the demand-driven funding system, including communicating more directly to students the impact of being academically underprepared (by lacking the requisite level of assumed subject knowledge) on students' likelihood of finishing their STEM degree. The need for universities to ensure that the output of their courses is meeting industry needs was also discussed.

Some Summit submissions suggested consideration of alternative rewards for studying challenging STEM subjects in senior secondary, such as ATAR bonus points, and a greater role for work experience placements for STEM-related graduates.

8. Strategic coordination of partnerships

The importance of partnerships between schools, industry and universities was a strong theme of the day. Many participants noted the great number of partnerships and program in existence around Australia. Schools can feel overwhelmed and uninformed about which are the most effective available partnerships for their students.

"As a Head Teacher of Science, I get in a week probably 50 emails or phone calls about challenges, competitions, summer schools etc and there is no coordination. I am swamped. There is nowhere I can go to find out what is available; so what teachers in schools tend to do is stick with the ones they've always known."

There was a view that many partnership programs are focused on encouraging students to choose STEM at university, but few target primary or junior secondary students or science and maths teachers. Regional and low SES schools can also struggle to engage with these partnerships.

Industry sees the education system as fragmented and disconnected and this can make forming partnerships frustrating and difficult to scale up. There was strong agreement about the need for government brokerage and strategic co-ordination of these partnerships.

A more strategic approach would help to increase and target industry investment in partnerships with schools, reduce duplication and help to identify gaps where additional effort can be targeted. More effort and attention is needed to measuring the impact of these initiatives and replicating what works.

"The problem in Australia is we are frightened of scale so we would rather have 200 programs than five big ones that would make a difference to thousands of people."

Summit submissions noted that successful international models of collaboration, such as school clusters and hubs formed with tertiary education providers and industry, could inform the development of new and more effective partnership approaches in Australia.

The STEM Education Summit was a dynamic and idea-rich discussion. The Summit discussions raised a great many ideas and proposed a number of solutions, which will inform the national STEM education strategy development.