Australian Government

Chief Scientist

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ADDRESS TO THE AUSTRALIAN INDEPENDENT SCHOOLS STEM LEADERSHIP CONFERENCE

20 MIN SPEECH AND 20 MIN Q&A

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Choosing the STEM path

Australian Technology Park
Eveleigh

I can think of many excellent reasons to study science or mathematics at school.

There is money.

Of the world's wealthiest 100 people, one in four have STEM qualifications – double the number with business degrees; and three times the number of economists.[1]

There are jobs.

The ABS tells us that the number of people in jobs commonly held by people with science credentials is growing at 1.5 times the rate of other jobs.[2]

People with STEM qualifications are more likely to be employed than those with non-STEM qualifications at the same level.

They are also more likely to hold down professional or managerial roles.

That aligns to international research, which suggests that 75% of the fastest growing occupations globally require science skills and knowledge.

It also reflects a new determination amongst the nations of the world to put their best and brightest on a science pathway.

Consider the US – which one survey suggests *already* spends $1.2 trillion every year on training, recruiting and developing STEM workers.[3]

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[1] Davidson, L. "What degree should you study to become a billionaire?" *Telegraph,* 25 March 2015. http://www.telegraph.co.uk/finance/jobs/11493648/What-degree-should-you-study-to-become-a-billionaire.html.

[2] Australian Bureau of Statistics, *Perspectives on Education and Training: Australians with Qualifications in Science, Technology, Engineering and Mathematics (STEM), 2010-11*. Catalogue number: 4250.0.55.005. 2014.

[3] STEM Connector and University of Phoenix, "Growing A Strong STEM Workforce" (2014). http://cdn.assets-phoenix.net/content/dam/altcloud/doc/industry/Growing-a-Strong-STEM-Workforce.pdf

The Bureau of Labour has calculated that, in ten years' time, the US economy will need one million more STEM workers than it is currently on track to have.[4] Fields like computing already have five vacancies for every jobseeker with computing skills.[5]

And so the Obama administration has committed to meet the gap, as a national priority.

As part of that, they have set out to prepare 100,000 high achievers in STEM to be outstanding STEM teachers.[6]

There will be competition for STEM skills across the world – and opportunities for Australian students who acquire them.

Then there is the capacity to contribute to society: in Australia or overseas.

When Australians are asked about the value of different occupations, scientists and engineers rank more highly than any group except doctors and teachers.[7]

That reflects our shared understanding that science is both the sword of progress and the shield against the problems that change creates.

Whatever goals we think are important (be it longer lives, a stronger economy or a cleaner world) we can be certain that scientists will need to play a central role.

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[4] Office of Science and Technology Policy, "One Decade, One Million STEM Graduates", December 2012. Online: https://www.whitehouse.gov/blog/2012/12/18/one-decade-one-million-more-stem-graduates.

[5] Brookings Institute, "Still Searching: Job Vacancies and STEM Skills" (2014). http://www.brookings.edu/research/interactives/2014/job-vacancies-and-stem-skills#/M10420.

[6] White House, "Preparing Americans with Twenty-First Century Skills", March 2014. https://www.whitehouse.gov/sites/default/files/microsites/ostp/fy_2015_stem_ed.pdf.

[7] Centre for the Public Awareness of Science, "How do Australians engage with science?" April 2014. Online: http://diffusion.weblogs.anu.edu.au/files/2014/05/Searle-S.D.-2014.-How-do-Australians-engage-with-science.-April-2014.pdf.

There is also a personal satisfaction that has attracted us to science for centuries.

As a scientist or mathematician:

- You think analytically: approaching issues in a systematic and critical way in search of underlying logic.
- You value objectivity: trying to avoid emotional responses in favour of evidence.
- You evaluate: assessing information based on the validity of the data and the reliability of the source.
- You question: the things you are told and the things you don't understand. Scepticism is an inherent characteristic of science.

That is important when we remember that a student in school today will probably live to see in the twenty-second century. Certainly, those starting this year will begin to enter the workforce in the late 2020s to 2030.

How are we preparing them now for what we can't possibly know in any detail?

We do know it is STEM that will shape the world our students will know and the jobs they might be called on to do. And those of them who have the skills to understand and excel in these fields will be far better placed to succeed.

Some of them will be scientists – but many more of them will be people using their science training to lead the way through changing times.

So there is no shortage of good reasons for students to choose STEM. There *is* a shortage of students making that choice.

Participation rates in science subjects at Year 11 and 12 are now at the lowest they have been in 20 years. [8]

In 2012 there were 30,800 more students in year 12 than in 1992 but 8000 fewer physics students; 4000 fewer chemistry students; and 12,000 fewer biology students than two decades previously.

The raw number of year 12 students taking maths is higher than it has ever been, but the vast majority (or 64% in 2012) now take it only at the general or elementary level.

Science and mathematics have not become any less interesting or important. Students are no less passionate or curious about the world.

But they are less likely than their parents to choose to study STEM in secondary school. And so they are more likely to struggle if they take a STEM course at university – or any of the myriad of courses that rely on mathematical literacy and critical thinking.

They are less confident in their ability to teach STEM if they choose education as their profession.

They will confront situations every day which call for STEM skills: understanding an issue in the media; choosing the right home loan; understanding a medical diagnosis.

And they will be more vulnerable to the snake-oil salesman and "ranting entertainers" who too often pass as informed commentators in our society.

That is a problem for a country that relies on teenagers making intelligent choices about the skills the country might need,

[8] Kennedy, Lyons and Quinn, *The continuing decline of mathematics and science in Australian high schools*, Teaching Science, Volume 60, Number 2, June 2014.

some distance away. And it is a problem that we – like other nations – can address.

We do have outstanding teachers and worthwhile programs, and it is important to recognise their achievements.

But we should not rely on the heroic efforts of individuals to carry what should be a national responsibility. We should make their achievements the benchmark for Australian education.

Too much of our STEM enterprise is tied up in small-scale projects, with short-term goals and no recurrent funding. Too few people who excel in STEM see real rewards in the teaching profession, and that is reflected in the shortage of specialist teachers. And too little appreciation is afforded to the demanding task of teaching STEM as it is practiced - as a dynamic and exciting human endeavour.

Consider that about 20 per cent of mathematics and physics teachers; and 30 per cent of ICT teachers, are teaching out-of-field.[9] [Bearing in mind that the current survey only requires a teacher to study a subject for one semester to be considered qualified.]

So we are struggling to fill the roles that we have.

About three quarters of physics teachers are male; and over 40% of them are aged over 50. Chemistry, ICT and general science courses also rely heavily on a cohort nearing retirement.

So we need to attract many more high achievers in STEM into teaching, just to maintain our unsatisfactory status quo.

[9] Weldon, Paul R. (March 2015). The Teacher workforce in Australia: Supply, demand and data issues. Policy Insights, Issue 2. Melbourne: ACER.

The achievement gap in mathematics between our best and worst performing states, as measured in international tests, is now equivalent to two years' worth of schooling.[10]

So we have significant disparities to make up, whilst setting the aspiration high for the national system.

So how to make STEM education a priority?

We cannot compel people to study STEM, or to teach it – but if we do our job right, we shouldn't have to. STEM is a choice that enriches the individual as much as it benefits their community.

Our challenge as a nation is to embed that understanding in everything we do. Our *specific* challenge as educators is to convey the same understanding far more clearly to our students and teachers.

Schools are critical: not simply because they nurture our abilities but because they shape our attitudes. They are the start of a very long pipeline – setting the pattern of our workforce into the twenty-second century and beyond. And so we need a strategy that engages all of us – educators, researchers, vice-chancellors, employers and governments – in the shared challenge of supporting our educators.

Last year I put a series of recommendations for strengthening Australian STEM to the Commonwealth Government. My recommendations about education and training were part of that suite.

The time has now come to turn recommendations into actions.

At last month's Commonwealth Science Council meeting the Prime Minister signaled his strong support for an ambitious

[10] OCS analysis.

whole-of-government response. With the Science Minister, I will shortly be leading consultations on the detail of this response.

I hope educators will be strongly represented in that process; and active participants in the changes that follow.

Through this plan, we would see a national strategy for STEM education, uniting independent and government schools, with clear goals, common datasets, and shared commitment.

We would recognise the importance of STEM in the national curriculum.

We would use NAPLAN data to identify schools which excel in STEM education, and work out how to scale up their success.

We would keep teacher workforce datasets that would alert us to shortages, and encourage education faculties and students to fill them.

We would expand the involvement of our publicly funded research agencies – like the CSIRO – in school education programs.

We would work with business and universities to show students the need for STEM – and the relevance of classroom learning to real-world concerns.

Above all, we would do a much better job of recognising and supporting STEM teachers for the vital role that they perform.

We would bring active scientists, engineers and mathematicians into the design and delivery of teacher training courses – bringing with them the excitement of STEM as it is practised.

And we would help schools to open professional development opportunities to their staff – and thereby up-to-the-minute knowledge to their students.

In my time as Chief Scientist it has been my privilege to hear from leaders in STEM education across Australia.

I have had my critics – who accuse me of diverting students from their natural destiny as lawyers or economists – but I have also had many supporters.

I believe we have seen a genuine shift in the perception of STEM and laid the foundations for significant change.

It is up to all of us to realise that change for every student.

Thank you.