DIGITAL SKILLS & CAREERS

Building the skills today for the jobs of tomorrow

FEBRUARY 2015

aiia
australian information industry association

CONTENTS

EXECUTIVE SUMMARY

DIGITAL SKILLS ARE ESSENTIAL FOR THE 21ST CENTURY

Digital technology is essential to Australia's competitiveness in a global world where digital skills are core to the productivity and innovative capacity of all economies.

Digital skills are more than just being able to use computers and applications. They involve the ability to design, build or program computer applications to help create new products and services. Digital skills use what is described as "computational and design thinking", the ability to understand how digital technology can be used to do new and innovative things.

By strengthening digital skills in our schools, Australia will give young people core capabilities in logic and critical thinking. These skills will improve their job prospects and we will improve our national innovation capability for the future.

Many countries, including the United States and United Kingdom, are enhancing digital skills in schools. They are teaching their children from the start of their schooling to write computer code so they can be active creators and controllers of technology instead of just passive users.

AUSTRALIAN PARENTS VALUE DIGITAL EDUCATION

Newspoll research commissioned for this paper shows that Australian parents value digital skills and careers for their children.

- In terms of digital careers, 95% of parents would encourage their children to pursue a digital career, if they are interested in it.
- 8 in 10 parents think that digital skills and computer programming should be integrated into primary and secondary curricula.
- When asked about digital skills, 61% of parents think it is important that children learn how to design, build or program computer applications.

OUR VISION

Our vision is that all Australian primary and secondary school students are exposed to at least basic computer science and digital technology techniques; learn to program; understand computational and design thinking; and receive the basic skills necessary to support post-secondary education in all fields which will inevitably demand a good level of digital competency.

Like other forms of literacy, teaching students to have deep skills as both digital consumers and producers takes time and requires an investment from Foundation through to at least Year 10. Parents see the need for this investment – now is the time to deliver our vision to all students, and ensure Australia's long-term economic competitiveness.

WHY IS DIGITAL EDUCATION IMPORTANT?

ESSENTIAL SKILLS

Today the world of networked computing pervades every part of our personal and professional lives. Understanding computer science is fundamental to understanding how our world works. It is an essential skill. Every school student learns the workings of Mathematics, English, and Science over their journey from Foundation to Year 10. We do this because these disciplines allow us to understand the world we live in, and because we recognize that learning this material takes time. Similarly, all students should have the opportunity to learn the workings of the digital systems that are shaping their future.

> ***"Computer science is something that we have been calling the ' fourth science' for some time… We believe that it is every bit as important as physics, chemistry and biology."***
>
> -- Michael Beswich, Director of Education, Microsoft UK

In the next ten years as more services are digitized and more processes are automated, more jobs will require digital skills. Digital technology will become an even bigger part of our homes and workplaces. This digitisation is setting the scene for fundamental transformations in our economy. It is important that young people not only know "how to use" technology, but they also know "how it works", and how it can be used to create new content and applications.

BETTER JOBS

Information communications technology (ICT) or digital technology is a major driver of employment in Australia. It creates high value and well paid jobs in all sectors of the economy such as mining, finance and retailing industries, as well as in the digital technology industry itself.

Australia's ICT market is the fifth largest in the Asia Pacific region and the 14th largest in the world. Over the last ten years, more than 100,000 new jobs were created in the ICT sector. While national employment levels have risen by around 14 per cent over the past decade, ICT professionals have seen a

growth of nearly 50 per cent over the same period. Computer-related jobs are projected to expand for years to come, making it an important source of employment growth for the future.

Employment outcomes for graduates from ICT-related courses are positive, with 74.7 per cent of computer science graduates, and 79.5 per cent of electronic and computer engineering graduates, securing full-time employment upon completion of their courses. In the longer-term, current trends suggest there will be more demand for IT workers than supply. The ACS/AIIA Report forecasts that a shortfall of 25,000 IT jobs by 2020.

Traditional jobs are also being disrupted by digital technologies with predictions that half of all existing jobs could be threatened over the next 20 years (Oxford Martin, 2013). Professional jobs such as lawyers and financial analysts, as well as manual and semi-skill occupations that will be vulnerable, as technologies such as automation and artificial intelligence are applied to more and more industries.

Digital skills are increasingly important in most occupations. Digital skills are essential to jobs in industries as diverse as manufacturing, professional services and public utilities, the creative industries, mining and agriculture. It is expected that digital skills will help future workers manage the disruption in their employment and transition to new occupations that are more productive and better paid.

The shortfall in digital skills limits the innovative capability and productivity growth of many Australian industries, which rely on information technology. A key reason for digital skills shortages is that domestic enrolments in tertiary level ICT courses have declined at alarming rates over the last decade.

> ***'The most important thing Australia absolutely has to do is build a worldclass technology curriculum in our K–12 [kindergarten to Year 12][…]'.***
>
> -- Matt Barrie, founder of freelancer.com

MORE NATIONAL INNOVATION

Learning these skills isn't just important for the job prospects of young Australians – it's important for our country's future. If we want Australia to continue to be a prosperous country, we need young Australians to master the tools and technology of the future.

The digital economy is becoming a key generator of wealth across the globe. Oxford Economics estimates the total size of the digital economy at

$20.4 trillion, which represents approximately 13.8 per cent of all sales across the world economy. Information technology is and is likely to continue to be the key driver of productivity growth in the twenty-first century.

Technology investment and skills are critically related when it comes to improving business productivity. Research by the Australian Industry Group (Ai Group) in 2012 found that 33% of businesses that invested in new technology reported improved labour productivity, compared with just 16% of businesses that did not invest. Of businesses that reported productivity growth, 40% said the main contributing factor was staff skills and capabilities. We need more young Australians to understand computer science because all of our industries need an inflow of workers who can develop and implement innovation through digital technology.

SMARTER NATION

The purpose of digital education is not only economic. Computer science is a serious academic discipline in its own right. Computer science involves problem-solving and creativity. Students learn to use logic and design-based thinking to resolve complex problems.

Computer science also complements other disciplines by giving students access to digitally-based analytic tools. Students can use computational thinking skills to help solve problems in medicine, science, mathematics, business and social sciences. It teaches and reinforces critical design-thinking skills that are not taught in traditional sciences or mathematics.

> ***"Computer programming is like music and every child will benefit in some way from being taught the basics at an early age,"***
>
> -- Charles Armstrong, CEO of Trampoline Systems.

WHY START YOUNG?

In an increasingly networked and digital world, computer science is a key foundation skills, alongside literacy and numeracy. Just like literacy and numeracy, students need to develop computer science foundation skills from primary school to enable them to develop critical skills and progress to more advanced courses at the secondary and tertiary level. **This has been recognised by Australia's peers overseas, with the United Kingdom introducing computer coding as a mandatory subject in all primary schools in September 2014.**

Australian research has also found that age impacts students' interest in studying ICT, with interest peaking between ages 12 – 15. Delaying the introduction of these subjects until secondary school is too late as students may have already decided against further study in the area or a career in ICT.[1]

With Australia falling behind other countries, (such as the US, UK and China) in Science, Technology, Engineering & Maths (STEM) and ICT capability, we need to take decisive steps to increase skills and interest in this area. Delaying the technologies skills study until secondary school is simply too late in terms of national skill development and the ability to influence the career choices of young people.

1. Dr K MacPherson (2013), Digital Technologies and Australian Teenagers: Consumption, Study and Careers, available at: http://www.canberra.edu.au/researchrepository/file/fde6c9c8-0f73-47a6-afb2-e476699be44b/1/full_text_final.pdf

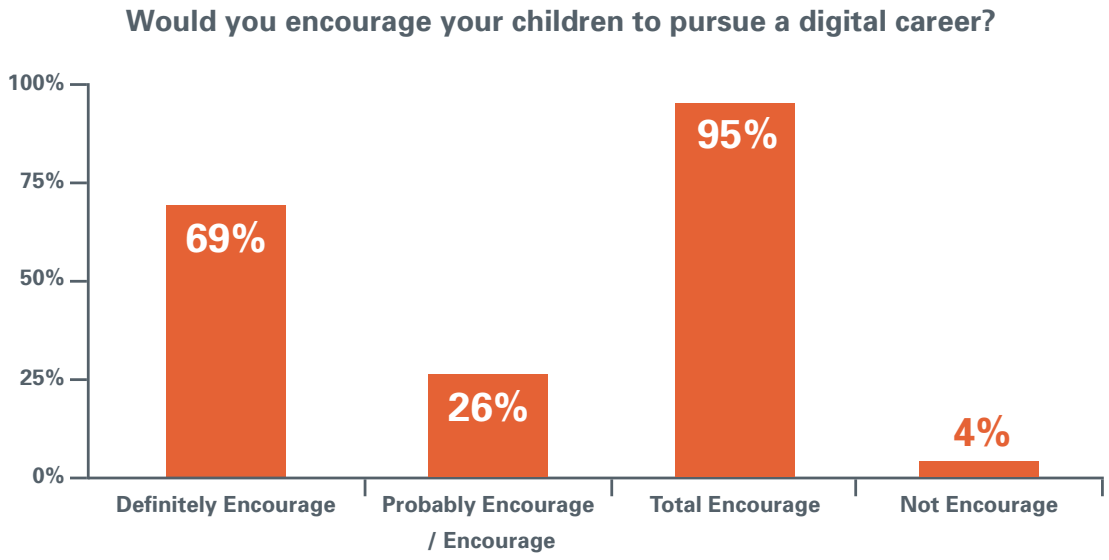
PARENTS VIEWS : NEWSPOLL

NEWSPOLL

Newspoll conducted research on behalf of the three sponsors in November 2014 to understand Australian parents' attitudes to digital skills. The telephone survey was conducted nationally among 1208 adults.

PARENTS BELIEVE DIGITAL CAREERS ARE ATTRACTIVE

In terms of digital careers, 95% of parents would encourage their children to pursue a digital career, if they are interested. 83% think a digital career is interesting and rewarding and 62% think a digital career is well paid.

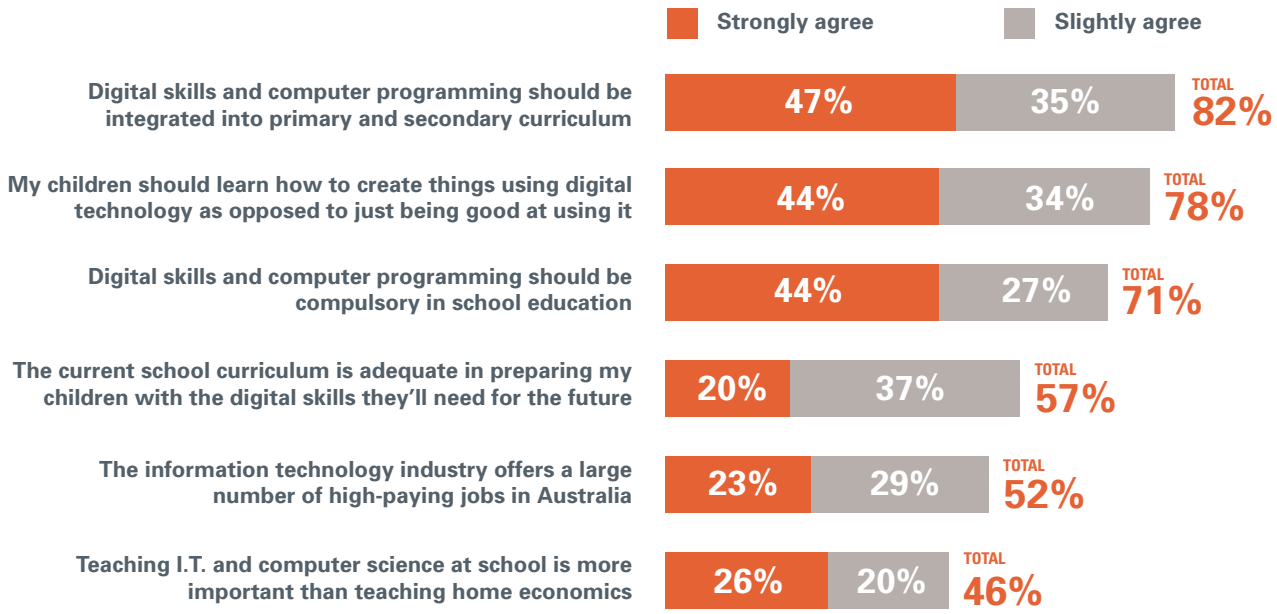


69% of parents would definitely encourage their children to pursue a digital career. Another interesting finding: despite the current gender imbalance in the workforce, 95% of parents think that future digital careers would be equally suitable to both males and females.

PARENTS WANT DIGITAL TECHNOLOGIES TAUGHT IN SCHOOLS

8 in 10 parents think that digital skills and computer programming should be integrated into primary and secondary curricula.

How should computer science be taught in schools?



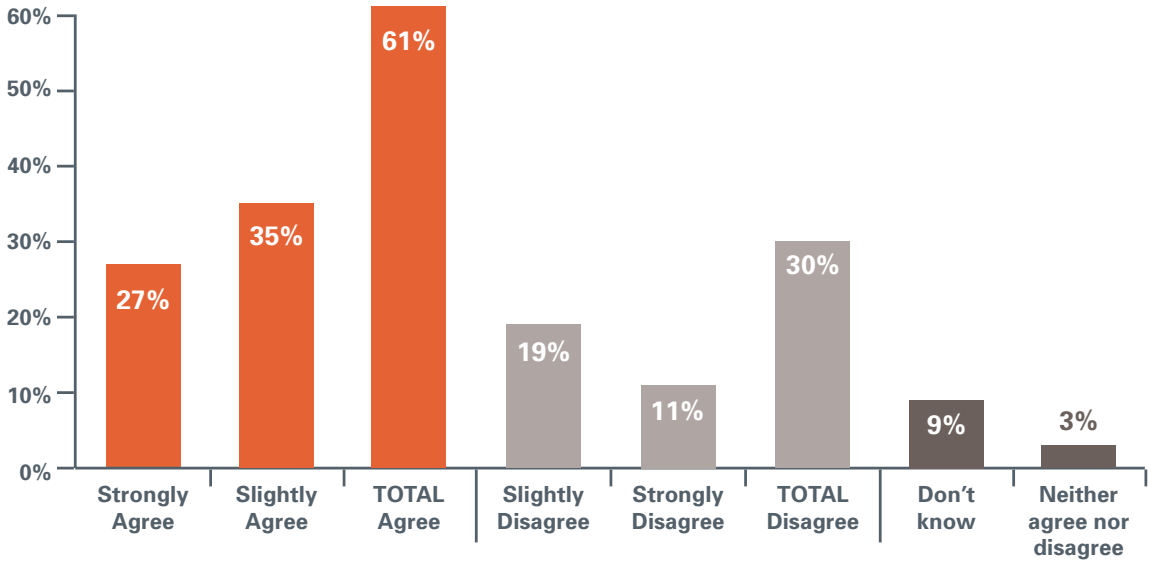
Interestingly attitudes and opinions towards digital skills tend to be more positive among parents with lower levels of education. More than sixty per cent of parents whose highest education attainment was school education believed that digital skills should be incorporated into school curriculums, compared with just over 40 per cent of parents that had been to university.

% who strongly agree by level of education (highest level of education they have completed)	Primary / Secondary School	College / Appren-ticeship	University Degree
Digital skills and computer programming should be integrated into primary and secondary curriculum	62%	47%	41%
My children should learn how to create things using digital technology as opposed to just being good at using it	55%	40%	41%
Digital skills and computer programming should be compulsory in school education	61%	44%	35%
Teaching I.T. and computer science at school is more important than teaching home economics	34%	17%	29%
The current school curriculum is adequate in preparing my children with the digital skills they'll need for the future	29%	14%	21%
The information technology industry offers a large number of high-paying jobs in Australia	19%	27%	22%

PARENTS BELIEVE COMPUTER SCIENCE SKILLS ARE VALUABLE

When asked about digital skills, 61% of parents think it is important that children learn how to design, build or program computer applications while 30% do not think it is important.

Is it important that children learn how to design, build or program computer applications?



Digital skills were defined as: "not the ability to use a computer but the ability to design, build or program computer application). For example, the ability to build an app for a smartphone or a tablet as opposed to just being good at using what someone else has built".

INTERNATIONAL DEVELOPMENTS

UNITED STATES

There is a growing momentum in the United States to enhance computer science education in schools. In 2013, U.S. President Obama called on students, teachers, businesses, foundations, and non-profit organizations to support computer science education for all students from kindergarten to seniors.

> ***"Computer science in America's schools … isn't just important for your future – it's important for our country's future. If we want America to stay on the cutting edge, we need young Americans like you to master the tools and technology that will change the way we do just about everything."***
>
> -- President Obama addressing students during Computer Science Education Week, December 2013.

This year the President announced a range of commitments to give millions of American students access to computer science education.

These commitments include[2]:

- Commitments by more than 60 school districts, including the seven largest school districts in the country, to offer computer science courses to their students. Together, these districts reach over 4 million students in more than 1,000 high schools and middle schools, in partnership with Code.org.
- Over $20 million in philanthropic contributions to train 10,000 teachers by fall 2015 and 25,000 teachers to teach computer science to in time for the school year beginning in fall 2016.
- New partnerships by the National Science Foundation (NSF), including a new Advanced Placement (AP) Computer Science course by the College

2. See White House (2014) FACT SHEET: New Commitments to Support Computer Science Education.

Board that emphasizes the creative aspects of computing and a focus on real-world applications. Leading partners, including Teach for America and the National Math and Science Initiative, will assist in implementation and scale-up of the course.

- New steps to increase the participation of women and under-represented minorities in computer science, including a new computer-science classroom design prize and innovative outreach efforts.

> ***"We're in a golden age of computer science"***
>
> -- Bill Gates, Founder of Microsoft

UNITED KINGDOM

The British Government has recently made a major effort to increase the level and quality of computer science education in schools.

> ***"We're not doing enough to teach the next generation of programmers. One of the things you hear from the businesses here in Tech City is "I don't just want people who are literate in technology, I want people who want to create programs", and I think that's a real wake up call for us in terms of our education system."***
>
> -- David Cameron, Prime Minister, Tech City interview, November 2011

The Education Secretary, Michael Gove, criticized the existing quality of computer science in schools, saying "ICT in schools is a mess". He outlined a bold new vision.

> ***"Imagine the dramatic change which could be possible in just a few years… Instead of children bored out of their minds being taught how to use Word and Excel by bored teachers, we could have 11-year-olds able to write simple 2D computer animations using an MIT tool called Scratch. By 16, they could have an understanding of formal logic previously covered only in university courses and be writing their own apps for smartphones."***
>
> - Michael Gove, Education Secretary, 2013

This vision has been backed with policy reform to implement a rigorous computer science curriculum.

From September 2014, the new national curriculum will require schools in England to teach the subject computing, which includes a substantial focus on computer science. This includes coding from age five. Pupils are taught problem solving techniques and how to create and debug simple computer programs, rather than focusing on learning how to use software programs.

For older school students, a new high-quality and academically demanding GCSE (UK leaving certificate) will be taught from 2016 to equip students with the skills and knowledge necessary to prepare them for further and higher education, and employment. The new GCSE will cover the fundamental principles and concepts of computer science including logical and creative thinking as well as the practical skills of designing and testing computer programs.

A British Department for Education spokesperson said: “We need to bring computational thinking into our schools. Having computer science in the EBacc will have a big impact on schools over the next decade. It will mean millions of children learning to write computer code so they are active creators and controllers of technology instead of just being passive users. It will be great for education, great for the economy, and will help restore the spirit of Alan Turing and make Britain a world leader again.”

WHAT'S NEXT: BUILD THE SKILLS TODAY FOR THE JOBS OF TOMORROW

It's clear that the countries to whom Australia traditionally looks for economic inspiration, such as the USA and UK, are recognizing the importance of a new 'digital literacy' to their economic futures. Teaching literacy requires investment of significant time, which is why we teach subjects like English and mathematics from a very early age, and keep teaching them throughout a student's school life. True digital literacy – the ability to both consume and create using digital technologies – similarly requires a long-term investment in each student.

In December 2014, as part of their long term economic plan for England, the UK Government announced a new $67M five year program to train maths and science teachers, create new curriculum featuring computer science training and establish a national college for digital skills.[3]

More recently in February 2015, the Al Group released a report 'Progressing STEM skills in Australia' which reaffirms STEM skills as being essential for the future economic and social well-being of the nation, with employment in this area growing at about 1.5 times the rate of other jobs in recent years.

Despite this, enrolments and the number of graduates with STEM qualifications continue to decline and secondary school enrolments in mathematics and science are also decreasing. Accordingly the pipeline of STEM skills to the workforce remains perilous. " There is an urgent need to develop a national STEM skills strategy to lift the level of STEM qualified employees in the workforce to enable the Australian economy to be more competitive and prosperous".[4]

3. https://www.gov.uk/government/news/maths-and-science-must-be-the-top-priority-in-our-schools-says-prime-minister

4. http://www.aigroup.com.au/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/LIVE_CONTENT/Publications/Reports/2015/14571_STEM%2520Skills%2520Report%2520Final%2520-.pdf

The effort required to build digital capability deep into our society is critical to our future economic success. Fortunately, the future needs of our economy and the desires of parents are strongly aligned. Future generations of Australians be equipped with the digital technology skills necessary to drive Australia's future economic development and competitiveness.

It begins with curriculum, pedagogy and properly skilled teachers, and should be coupled with a national commitment to building appropriate digital infrastructure. In parallel, industry should also commit to the changes needed to remain innovative and competitive in a digital society, including the products and services they offer, the skill mix of their staff, the way that they engage with their customers and improved collaboration with the research sector.

WHO ARE WE?

The research reported in this paper was jointly commissioned by the Australian Information Industry Association (AIIA), Australian Computer Society (ACS) and NICTA.

The general principles of this paper are also supported by the Australian Industry Group (AiGroup), Australian Council of Deans of ICT (ACDICT), Australian Council for Computers in Education (ACCE), Australian Mathematics Trust (AMT), Warren Centre for Advanced Engineering, Australian Academy of Technological Sciences and Engineering (ATSE) and StartUpAus.