August 2018

ICT Education in Queensland

Challenges and Solutions

Contents

Based on feedback and advice from experts, we have developed a set of challenges and potential solutions for improving ICT and Digital Technologies education in Queensland.

01 Foreword

In November 2017 ACS convened the QLD ICT Educators Forum, held at the State Library of Queensland.

The Forum brought together the state's top influencers and experts from education, industry and government to share their views and concerns, identify commonalities, and begin collaborating on sustainable solutions. There were three key issues tackled at the forum:

1. How to increase the number of ICT professionals being produced by our education system in light of the future needs of the Queensland economy.

2. How teachers and educational institutions can deal with the challenges of implementing the new national P-10 Digital Technologies curriculum.

3. How to encourage more students to take up technology and technical subjects.

One of the products of those discussions is the paper you're reading right now. In this paper, we've identified those challenges that are of most concern for ICT education in Queensland and the broader industry pipeline, and tried to provide solutions that will work for the sunshine state.

We've taken the feedback we received at the forum as well as advice from experts in ACS' Profession Advisory Board to develop a set of challenges and potential solutions for improving ICT and Digital Technologies education in Queensland.

[1] *See Appendix 1 for a list of forum attendees.*

In this paper, we adopt the conventions of the Australian Curriculum. Thus 'ICT' refers to the general capability of using technology. ICT encompasses the skills of proficient users. 'Digital Technology' represents an exciting subject in the curriculum, which focuses on creating solutions with digital technologies. This subject specifically aims to encourage computational thinking and prepare students to work in digital industries and businesses.

ABOUT US

ACS is the professional association for Australia's Information and Communication Technology (ICT) sector. The ACS has over 40,000 members and a presence in every state and territory of Australia.

ACS' vision is for a vibrant digitally-driven Australia with a capacity to create and commercialise innovative ICT products and services for the world market, as well as being effective users of technology to maximise productivity and quality of life for all Australians. To achieve this, ACS has defined a three-pronged strategy of:

- Building Capacity to ensure that we have sufficient technology professionals to meet our economic growth needs by encouraging more people into ICT and STEM (science, technology, engineering and mathematics) careers and attracting top talent from around the world.
- Increase Capability by developing superior skills and expertise in our people, establishing benchmarks, providing education, and identifying areas for focused attention which represent significant opportunity.
- Acting as a Catalyst to spark innovation and encourage both public and private sector organisations to embrace technology to transform processes and reimagine customer experiences.


/Promotion
/Research
/Business
/Development

Introduction

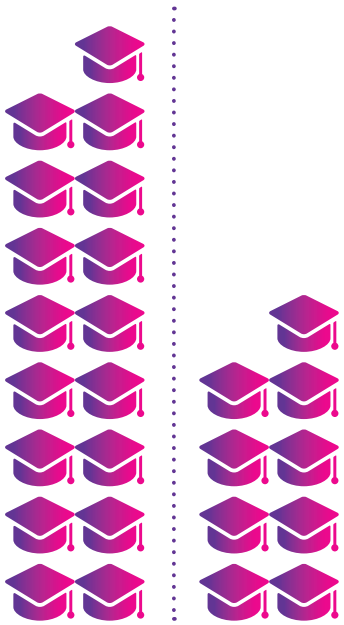
In September 2017, a team of students from a Queensland School travelled to Colombo in Sri Lanka with the support of the ACS to represent Australia in the South East Asian Regional Computer Conference (SEARCC) International Schools Software Competition. It was perhaps an unusual team, being predominantly female with a skilled and enthusiastic female ICT teacher.

If proof were needed that students in Queensland and throughout Australia are willing and able to embrace Digital Technologies when they are encouraged and inspired to do so, then this was it. The question is then, why do so few of them embrace this challenge?

Like much of Australia, Queensland is staring down the barrel of a substantial Digital Technologies and ICT skills gap. The continuing strong demand for Digital Technologies workers and skills is consistent with the significant role digital technologies will continue to play in driving Queensland's economic growth. The increasing digitisation of Queensland business operations across all sectors of the economy has resulted in greater integration between Digital Technologies functions and broader business operations, meaning that people need to be increasingly digitally literate to carry out their daily work—regardless of whether they're in a pure ICT field, or in another profession.

75%

OF THE FASTEST GROWING JOBS REQUIRE STEM SKILLS



2016→2022

12,000 NEW TECHNOLOGY PROFESSIONALS NEEDED TO MEET DEMANDS

Unfortunately, our education system has actually seen a decline in the performance of students in STEM and technical fields. In spite of the fact that roughly 75% of the fastest growing jobs require STEM skills[2], the past fifteen years has seen a notable drop in the performance of Queensland and Australian students in those subjects. According to the OECD Programme for International Student Assessment (PISA), Australia's rankings for science and maths have been on a decline since 2003, even as the OECD average rating for science skills has gone up.[3]

The drop in primary and secondary student interest in technical subjects has been reflected in tertiary and VET education as well. In 2003 there were 1695 domestic ICT degree graduates in Queensland. By 2016, that number had dropped to just 935.[4]

To provide some context for those numbers, between 2016 and 2022 Queensland will need about 12,000 new technology professionals to meet the demands of the growing digital economy.[5] That's about 2000 per year, or more than twice as many as the number of ICT graduates than universities are currently producing.

In Queensland, we are presented with an opportunity to address this issue as the new P-10 Digital Technologies curriculum is implemented in 2019. The new curriculum started being rolled out nationwide four years ago with the purpose of preparing Australian students for a future workforce in which technical skills are increasingly important.

[2]PricewaterhouseCoopers, "A smart move: Future-proofing Australia's workforce by growing skills in science, technology, engineering and maths (STEM)," PricewaterhouseCoopers, 2015.

[3]OECD Programme for Internation Student Assessment, "Programme for Internation Student Assessment," OECD, 2015.

[4]Department of Education uCube, "Custom report," Department of Education, 2016.

[5]Deloitte Access Economics, "Australia's Digital Pulse 2017," Deloitte Access Economics, 2017.

However, there is much more that needs to be done to improve the state of Queensland's digital skills pipeline.

For Queensland to fully capitalise on the tremendous potential of the global digital economy, there must be immediate action to create the right conditions, capabilities, capacity and commitment in our education and industry sector to whole-heartedly embrace this opportunity. The nature of the digital economy means that getting the balance right in Queensland will allow the state to have a significant leadership role both in Australia and on an international stage.

In building a talent pipeline that is sustainable and that addresses Queensland's immediate and long-term needs, a multi-faceted approach is crucial, incorporating elements such as developing Digital Technologies skills for all primary school teachers, and enhancing the specialist skills of Digital Technology in secondary schools. By boosting teachers' capabilities, they will inspire and encourage students' passion for possibilities in the ICT domain. Career guidance and industry engagement will also be pivotal in identifying and developing talent at all stages, as will integrating and fostering entrepreneurial skills with students' learning.

It's now time to focus attention on the new Digital Technologies subject and promote digital creativity problem solving skills.

02

Challenge 1

Getting teachers ready for the Digital Technologies Curriculum

The Digital Technologies Curriculum, approved by the Federal Government in 2015 and being implemented in Queensland in 2019, is a huge step forward for ICT education in Queensland and Australia. The curriculum is designed to engage students with digital skills from a young age, and is also designed to connect digital technologies with other subjects of interest to students.

The curriculum has two strands: knowledge and understanding, and processes and production skills. These two strands cover Digital Systems, Representation of data and Creating Digital Solutions. The curriculum also develops students' thinking through a variety of methodologies such as Design Thinking, Systems Thinking and Computational Thinking. Through Computational Thinking, students will develop their problem-solving skills by creating digital solutions. They will also learn to code in various programming languages to solve specific problems.

For many teachers and educational institutions, however, implementing the curriculum will be a huge challenge. Educators across the sector are often overwhelmed with the amount of information and resources available and have little time to build their own digital skills, or process large volumes of information in order to discern the best for them or their students. In addition, educators in the primary and secondary levels often have competing subject workloads, which further limits their time to develop deeper skills. They are concerned at how they will integrate the core skills required in the P-10 Digital Technologies Curriculum with their existing subjects.

In particular, primary school teachers are generalists in nature. They teach a range of disciplines, from maths and science, to English, history, sport, and art. For many primary-trained teachers, the P-10 Digital Technologies Curriculum is completely new and is not necessarily something they have current skills or training in. Nor may they have the expertise they will need to teach the specialised content of the Digital Technologies subject.

The challenge then, is how can we give Queensland's teachers the tools they need to provide the best Digital Technologies education to the state's students? Building teachers' skills and empowering them at all levels of the curriculum will be vital to giving them the confidence and capabilities to deliver the curriculum in a way that engages and inspires their students.

Right now, solving this problem is largely being left up to individual educational institutions based on their individual ethos and resources, but we believe more can be done

POSSIBLE SOLUTIONS

Solution 1:
A properly funded skills training program, with professional recognition for certified teachers.

Action stakeholders: QLD government, educators

The first step in getting teachers ready for the Digital Technologies curriculum will be the development a standardised, appropriately funded training program. Thus far there have been ad-hoc programs, such as the Teach Queensland P-10 Digital Technologies professional development online course from Griffith University, as well as workshops being run by national associations, but a broad-based teacher upskilling program still seems a long way off.

In Advancing Education: An action plan for education in Queensland, released by the QLD Department of Education and Training, the department committed to the establishment of a 'centre for professional learning and teaching excellence.' It also promised to establish a new classification system for teachers that rewards their expertise.[6]

We would like to see both of those projects moved along, to herald the development of a standardised set of learnings for teachers transitioning to Digital Technologies teaching as well as professional recognition of those skills.

Solution 2:
The development of a more standardised approach to the Digital Technologies curriculum.

Action stakeholders: QLD government

Right now the Digital Technologies curriculum is being implemented according to individual schools' ethos and resources. As with other subjects, a top-level view of expectations has been provided as a guideline by the Queensland Curriculum & Assessment Authority, leaving it to the individual institutions to develop a teaching programme. The likely outcome of this is that different schools will have wildly different outcomes with respect to Digital Technology learning.

Given the dynamism of Digital Technologies, we believe more guidance from the state level would be welcome, producing more consistent results across schools and regions as well as taking the pressure off schools and teachers to trawl through massive amounts of online resources to develop their own course plans. The creation of a standardised course plan, a set of hardware and software recommendations, pre-made activities and common online learning resources would be very useful for Queensland's educators. There are a range of resources currently online, and are a good start but none offer a fully integrated approach, we believe even more guidance would be useful for teachers tackling the daunting world of Digital Technologies.

[6] *Advancing Education, Queensland Department of Education, http://advancingeducation.qld.gov.au/Pages/default.aspx*

Solution 3:
Developing a network of Lead Schools and Master Teachers in collaboration with professional associations

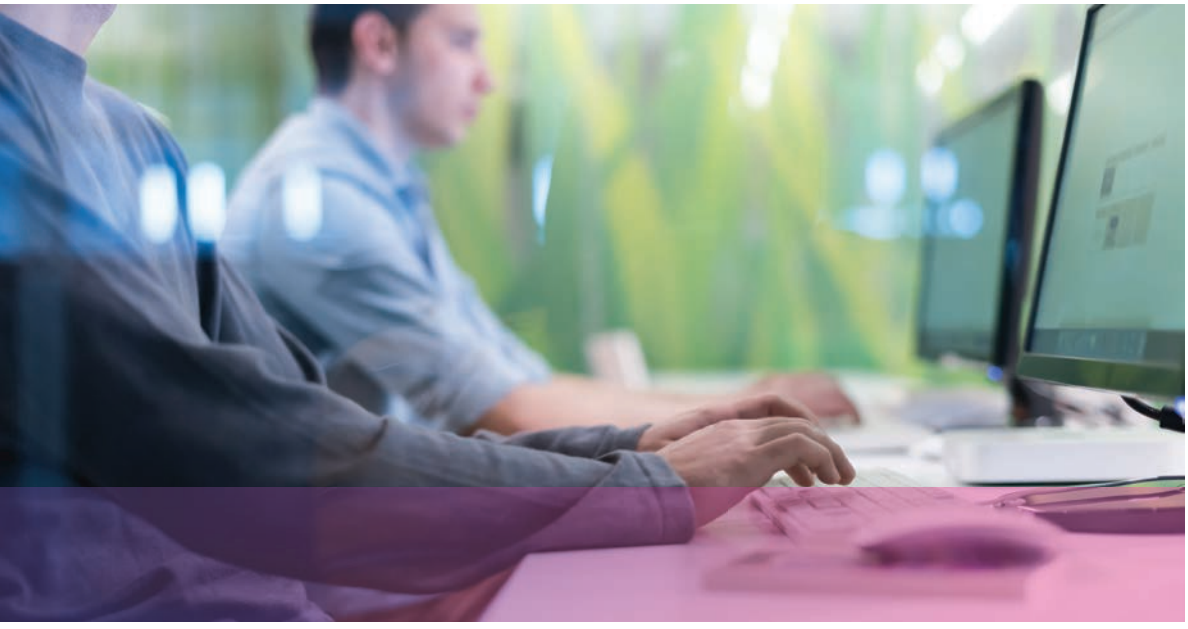
Action stakeholders: QLD government, educators, professional associations

Modelled on the UK's Network of Teaching Excellence in Computer Science, Queensland's education system could formally develop a network of leaders that can be used to bring other schools and teachers up to the standards required.

Under this scheme, Lead Schools publicly recognise Digital Technologies as an important curriculum subject and include it as part of their school development plan, with clear and strong support and advocacy from their Principals. It is expected that a Lead School would be proactively developing a broad and balanced Digital Technologies curriculum that shows clear, planned progression and thus have teachers who can become Master Teachers (see below). A Lead School would also volunteer to offer support to at least one other school in their area through sharing of good practice e.g. team teaching, lesson observations, shared schemes of work or running joint planning sessions. Lead Schools would be self-nominating but would be required to complete an activity audit each year in order to maintain their Lead School status.

Master Teachers are those who can demonstrate depth of subject knowledge coupled with extensive experience in the teaching of Digital Technologies. They are generally teachers who have followed an approved university provided continuing professional development (CPD) program to develop their subject knowledge, their understanding of pedagogy and their skills as a deliverer of CPD to other teachers. Master Teachers would provide local, on the ground face to face support to other teachers in their area.

This is not the only possible approach, of course. There are various research projects underway across Australia, such as the Principals as STEM Leaders project being undertaken at the University of Tasmania.



WE NEED PROGRAMS THAT DO A BETTER JOB OF ENGAGING STUDENTS IN ICT SUBJECTS EARLY

Challenge 2

Digital Technology's image problem

Although the reasons for the decline the number of students engaging in STEM and Digital Technologies in schools are not fully known, it's clear that computers and technology have an image problem among Queensland's students.

With no real consensus on what it means to work in Digital Technologies, it is difficult to communicate with the public about its value, or even the breadth of fields it contributes to. The field, and the terms 'ICT' or 'Digital Technologies', are so diverse and all-encompassing that it's difficult to identify any one aspect as wholly representative.

Common misconceptions of the Digital Technologies and ICT professions are that they are heavily based around coding, or that younger people are more naturally adept. And there's little information in mainstream media to refute this. The result is that the majority of people have a false impression of the industry and don't see a career in Digital Technologies as having the level of diversity, flexibility and reward they want. The impact of this disconnect has been a significant drop in available local talent, creating an environment where current demand far outstrips supply.

In order to combat this perception, we need programs that do a better job of engaging students in ICT subject early. Some possibilities include:

POSSIBLE SOLUTIONS

Solution 4:
Seek better engagement in early childhood.

Action stakeholders: Educators, ACS, industry

Teaching ICT from younger year levels is critical to building and retaining students' engagement in Digital Technologies – and something the new P-10 Digital Technologies Curriculum will promote. Rather than starting formal ICT studies at senior secondary school levels, or at university, introducing studies at earlier educational levels—such as in early primary schools—would give students the experience of seeing the subject develop and evolve, as well as how it integrates with and impacts the wider world around them.

However, there are additional programs that can help younger Australians engage with technology. Some of these are pilot programs, such as Early Learning STEM Australia (ELSA)[7], The Smith Family's Let's Count[8] and Froebel's Little Scientists Program[9]. We would like to see programs like these developed further, however, and be made more readily available to students across Queensland.

[7] *Early Learning STEM Australia, University of Canberra, https://elsa.edu.au/*

[8] *Let's Count, The Smith Family, https://www.thesmithfamily.com.au/programs/numeracy/lets-count*

[9] *Little Scientists, Froebel, https://www.froebel.com.au/about-froebel/little-scientists/*

Solution 5:
Connecting ICT to subjects that students care about.

Action stakeholders: Educators

One of the key ways to engage students in digital technology is to connect it to their other areas of interest. Technology needs to be recognised as a means to an end, rather than just an end in itself.

To that end, schools and teachers should be encouraged to combine digital skills into other disciplines. A program that educates schools and teachers that ICT is not a silo, and to encourage non-STEM specialists in secondary and tertiary education to learn an explore the possibilities of using digital tools in their field. That may require new training programs, either as an adjunct to existing digital technologies training programs or as stand-alone solutions.

Solution 6:
The development of innovation competitions and incubators.

Action stakeholders: QLD government, ACS and educators

These make computing and other technical fields look exciting for students. The National Innovation & Science Agenda has started positive work on this, and its efforts should continue to be supported, while additional grants at the state level can be used to shore up Queensland's competitive position.

Solution 7:
A program aimed at getting more female students involved in STEM learning.

Action stakeholders: QLD government, educators, ACS and industry

This program must involve the ICT profession and industry working closely with teachers, parents and career advisory professionals. Importantly, it should also involve identifying and utilising appropriate female ICT role models. It should also start early. Research shows that students make their decisions on gendered career pathways very early on, as early as primary school.

THERE IS A SIGNIFICANT DIVIDE BETWEEN METROPOLITAN AND REGIONAL QUEENSLAND

Challenge 3

Bridging the digital divide

Queensland's geographically diverse population presents unique challenges. Although telecommunications services continue to improve in metropolitan areas through commercial and technological developments, evidence suggests there is a significant digital divide between metropolitan and regional Queensland.

For example, Swinburne University's Australian Digital Inclusion Index (ADII)[10] found that regional Queenslanders are relatively disadvantaged in terms of access to, affordability of and ability to use digital services.

There was a notable gap in the ADII scores between Brisbane (which has an ADII score of 56.8) and Rural Queensland (51.7). North West Queensland is a particular problem zone, with an ADII of just 45.9, well below the national average of 56.5.[11]

As a consequence, the Queensland Government and education sectors needs to ensure that all Queenslanders have the opportunity to develop their digital skills. This means ensuring the adequate provision of broadband and computers as well as trained teachers to all regions. We need to immediately identify and address gaps in National Broadband Network (NBN) service provision for regional business and implement educational programs which develop digital skills and literacy within the community at all levels. After four years, schools have yet to fully implement the Digital Technologies subject, partly due to this wide diversity in digital access.

[10] *Australia's Digital Inclusion Index, Swinburne University, 2017, https://digitalinclusionindex.org.au/*

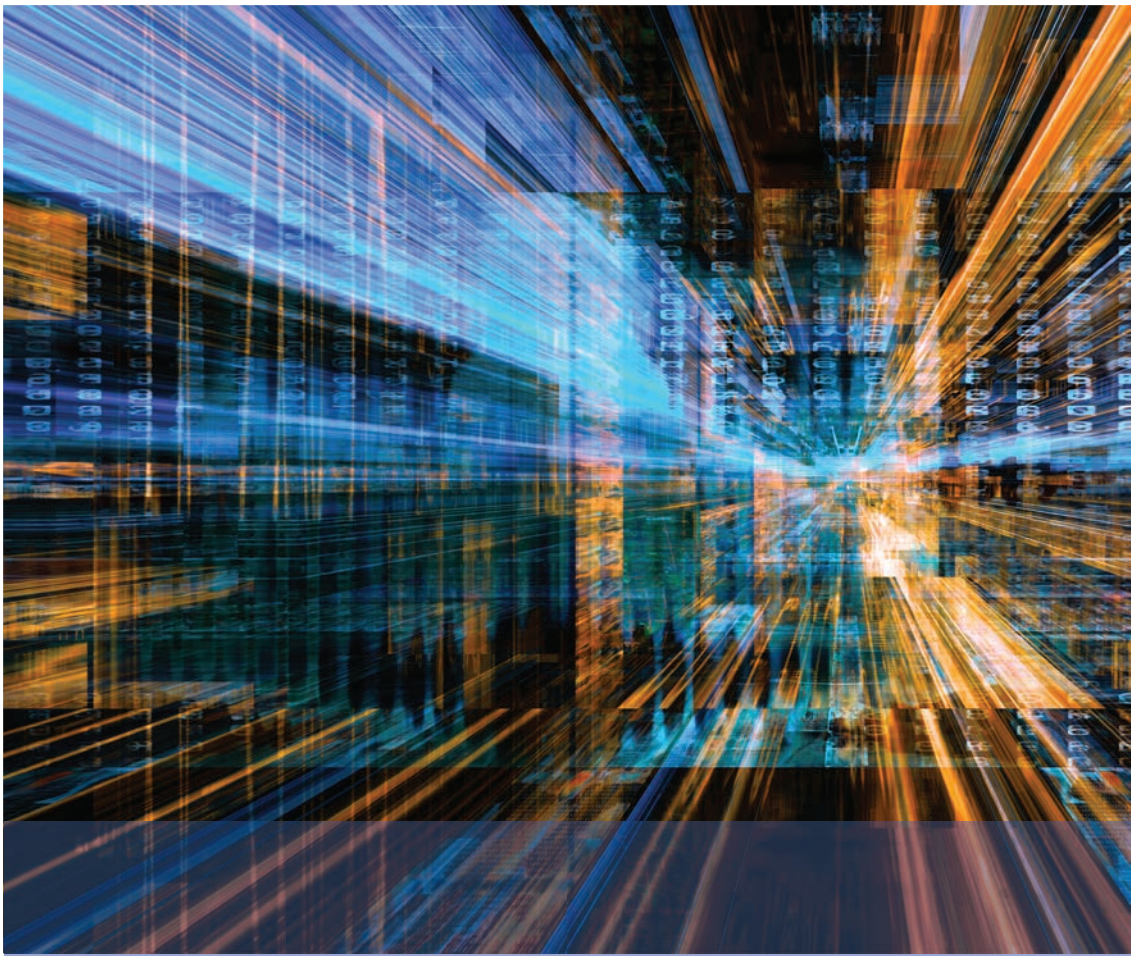
[11] *Measuring Queensland's Digital Divide, Roy Morgan Research, 2017, https://digitalinclusionindex.org.au/wp-content/uploads/2018/03/18710_ADII_QLD-Report-2017_FA_Web.pdf*

POSSIBLE SOLUTIONS

Solution 8:
Developing a baseline target for school equipment and broadband.

Action stakeholders: QLD government and educators

The development and enforcement of a set of minimum standards for Queensland's students would be a valuable exercise for Queensland. The standard could include minimum per-student bandwidth, rules regarding the provision of hardware and software as well as a standardised set of rules regarding internet access. Schools that are struggling to hit those targets should receive additional technical assistance from the State Government, with a plan to address gaps in NBN provision and equipment availability.



HELP TEACHERS UNDERSTAND THE RELEVANCE OF WHAT THEY ARE TEACHING STUDENTS

Challenge 4

Developing links between industry and education

With the coming implementation of the Digital Technology Curriculum, the challenge now is in taking a high-level view to find the most effective means of delivering it so that it achieves the goals we have set for it, academically and commercially. Industry engagement will be critical at every point, not just to inspire students, but also to help teachers understand the relevance of what they are teaching students now and how it will benefit them in the future.

There are potential opportunities for industry engagement through in-school 'micro credentialing' and trade certificate programs that would produce job-ready candidates. There are also internships, industry scholarships, and 'higher apprenticeships' that would allow students to build on-the-job experience while they learned, and give businesses the opportunity to develop their staff through their organisation from junior roles.

Improving the connectivity between schools, universities, and industry is critical to ensure relevance and engagement – not just in a straight line (i.e. primary-->secondary-->tertiary-->industry), but as an interactive network across all educational and professional levels that supports a wider culture of Life-Long Learning.

Improving the connectivity between schools, universities, and industry is critical to ensure relevance and engagement.

POSSIBLE SOLUTIONS

Solution 9:
Develop partnerships between industry and academia.

Action stakeholders: QLD government, ACS, educators and industry

Governments and universities can help facilitate partnerships between industry and academia that exposes students to mentors in high-tech industries through training sessions, internships and the like. This will help eliminate stereotypes and make a career in STEM fields a more appealing prospect. The STEM Partnership Forum, for example, was first proposed by the Education Council and had its first meeting in 2017, and we endorse its efforts to develop a platform for connecting students with mentors.

The model used in the UK's Network of Teaching Excellence in Computer Science is another avenue in which such partnerships could be achieved. In the UK model there are currently ten university-led Regional Centres. These Centres bring academic strength and rigour to the network and increase the attractiveness of events and activities to teachers in each region. Industry partners work with the universities to strengthen, reinforce and complement this academic strength. By providing a centre of activity around which other local/regional initiatives can cluster, and with which they can be aligned, the university and industry partners allow the program to benefit from the existing networks and relationships that they have each developed over time and to leverage other relevant activities being run by them.

Challenge 5

Recognising and developing soft skills

Historically soft-skills were an assumed attribute. As our society has changed and their relevance recognised there needs a recognition that these skills are not inherent but need to be taught. These skills are highly transferrable and make career changes easier as the workforce evolves.

These skills have proven to be particularly valuable in the Queensland ICT workforce. The fastest growing positions in ICT are jobs like ICT project manager, business analyst and ICT product manager – jobs that require capabilities beyond purely technical skills. We're seeing a move to more 'T-shaped' skillsets in the ICT workforce – that is, needing solid generalist skills, including personal and commercial acumen, interpersonal skills, and project management – along with deep expertise in a specialist field. In fact, the usefulness of those skills is such that LinkedIn data suggests that more than 40% of ICT workers had a previous role that would not have been classified as an ICT occupation.[12]

By developing more flexible skillsets amongst our student populations, we can develop alternate pathways to careers. Creating alternative pathways to jobs and careers will also play a fundamental role in helping students and career changers adapt to the fast pace of the tech sector, and help supply more immediate and mid-term demand in the market for talent.

THERE NEEDS A RECOGNITION THAT SKILLS ARE NOT INHERENT BUT NEED TO BE TAUGHT

[12] *Deloitte Access Economics, "Australia's Digital Pulse 2017," Deloitte Access Economics, 2017.*

POSSIBLE SOLUTIONS

Solution 10:
Integrate soft skills into the curriculum at all levels

Action stakeholders: QLD government and educators

Some universities have already implemented professional practice courses, and we recommend their development in primary and secondary education as well. To go along with that, we need teachers in schools, VET and university, who have training and formal qualifications in how to teach these skills.

THE CURRICULUM WILL NEED TO BE REDESIGNED TO INCORPORATE DATA SCIENCE ELEMENTS

Challenge 6

Planning the future curriculum now

Much of the Queensland & National Curriculum is predicated on pre-digital content and ideas. As computing power becomes ubiquitous and widely used in society, the curriculum will need to be re-designed to incorporate data science elements where these make sense.

There is already significant educational research which has shown how smart computing use can boost student mathematical understanding by several Year levels. We need urgent conversations on how computers can enhance our curriculum, not just sustain the old one. This research and social consultation will take time, so we need to plan for the future.

POSSIBLE SOLUTIONS

Solution 11:
Consult educational stakeholders on the role of computers in the school curriculum

Action stakeholders: QLD Government, ACS, educators

By encouraging research into developing enhanced learning using computers, there will be strong evidence available for data-driven curriculum decisions. Parents, students and educational researchers need to work together to define what the extent of computer use in schools should be. One example is that of examinations. Finland has converted its Year 11/12 exams to be undertaken on computers. Is it time for Australia to catch up?

HOW ACS QUEENSLAND CAN HELP

ACS QLD is prepared to do its part to help Queensland's next generation become the tech heroes of tomorrow. Some of the projects we're undertaking include:

- Strengthening collaboration between industry and the education sector. This includes making ACS QLD members available to help develop course content and provide real-world projects for students, creating a support network for teachers, and developing partnerships with high schools and universities.

- Helping the professional development required for teachers to implement the new digital technologies curriculum. This includes the provision of the ACS Teacher PD program; the development of a community of practice to allow teachers to collaborate and share experience with other educators throughout Queensland; and a program to connect teachers to industry professionals.

- Creating industry pathways, which include practical on the job training. These can utilise existing resources, such as libraries, community and indigenous centres and infrastructure to provide regional Queenslanders with the opportunity to compete on an international skills level.

- Developing strategies that improve the perception of the IT industry to those outside of the industry and to both students and parents. This includes promoting the level of diversity, flexibility and reward a technology career offers.

- Engaging with students at all ages via partnerships and collaboration with schools in QLD.

ACS QLD is prepared to do its part to help Queensland's next generation become the tech superheroes of tomorrow.

03 Appendix

QLD ICT Educators Forum Round Table Participants:

Company	First Name	Last Name	Title
Brisbane Marketing	Danika	Bakalich	Talent & Skills
Independent Schools QLD	Jo	Wise	Director - Education Services
KGSC	Sue	Isbell	Head of eLearning
State Libraries QLD	Vicki	McDonald	CEO
ACS	Therese	Keane	Chair - ICT Educators Board
QCEC	Maire	Previte	Executive Officer - Education
ACS	Allyn	Radford	Director Education
CSIRO	Sarah	Hayton	Program Delivery Manager Education and Outreach
QASSP	David	Turner	Director Professional Development
TAFE GC	Richard	Barrett	Director of Faculty, Creative Industries, Business, IT & Service
Qsite	Ben	Paparoulas	President
ACS	Mike	Driver	Vice Chair - ACS IT Educators Board/ ACS QLD Chair
Sunshine Coast Council	Anne	Lawrence	Head of economic development
Agitliy Applications	Darren	Oliver	CDO
DSITI	Michelle	Carter	Director, Digital Economy and Productivity
TechnologyOne	Brett	Hooker	Group Director R&D | Research & Development
TAFE QLD	Jackie	French	Team Manager IT, All Campuses
National Curriculum Developer	Paula	Christophersen	

About ACS

ACS is the professional association for Australia's Information and Communication Technology (ICT) sector. More than 40,000 ACS members work in business, education, government and the community. ACS exists to create the environment and provide the opportunities for members and partners to succeed. ACS strives for ICT professionals to be recognised as drivers of innovation in our society, relevant across all sectors, and to promote the formulation of effective policies on ICT and related matters. Visit www.acs.org.au for more information.

ACS
International Tower One
Level 27, 100 Barangaroo Avenue
Sydney NSW 2000

P: 02 9299 3666
F: 02 9299 3997
E: info@acs.org.au
W: www.acs.org.au