



2017 ANNUAL REPORT



A Centre of Excellence & Innovation in Science & Mathematics



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Director's Message

We began the year reflecting on Quantum Victoria's suite of programs and proceeded to look at how best to support the growing and different needs of school communities throughout Victoria. The Centre's vision of adopting a scalable outreach model, delivering asynchronous Courses for students and teachers, began to take effect through the development of the 'QV Online Portal' and the redevelopment of the QV website.

A Focus Group of experts from universities, industry, government and schools was enlisted on the 2nd of June, as a critical friend, reviewing existing practice and informing the future direction of the Centre. The Focus Group was not a formal body with governance responsibilities, but an informal group of interested and committed individuals imparting knowledge to improve STEM teaching and uptake, in Victoria and more widely. A number of suggestions were made and those that fall within the scope of the Centre's Operational Funding Model and Governance structure have been adopted.

Global Cyber Security threats led to the development of two new programs and a state wide Challenge, the first of its kind in Australasia. The purpose of all three initiatives was to:

- Generate interest with students about the opportunities in the cyber security landscape.
- Create awareness amongst students of the potential risks associated with their online activities.
- Engage students in real-life Cyber Security Scenarios.
- Equip students with the skills needed to be active participants in the cyber workforce.
- Raise an awareness of the importance of cyber security education.
- Inspire enthusiasm about career opportunities in STEM-related areas with all students.

One of the Centre's aims was to provide all students with role models in the STEM disciplines. This led to the development of a series of five **'Women in STEM – STEM Capabilities for the 21st Century'** state-wide student events. These events showcased prominent women in different STEM disciplines and immersed students in workshops developed and delivered by the Quantum Victoria team, focusing on the knowledge and skill set necessary for the ever changing, STEM rich workforce.

The Quantum Victoria **'PrintACar Challenge'** was in its fourth year and attracted over 140 Victorian Primary and Secondary students across both Qualifying Days. Eighteen teams went on to compete in the Final, hosted at La Trobe University, during the Engineering and ICT Showcase Event. The overall winner for 2017 was the 'Kings of Kaniva' from Kaniva College. The winning students were awarded an Arduino kit, a trophy and a 3D printer for their school. The Challenge will be expanded in 2018 and will now include an overall Primary and an overall Secondary winner, with each winner receiving a 3D Printer for their school.

We also incorporated the Quantum Victoria game interface into select programs, enhancing the experience for the students and teachers and giving rise to the bespoke 'Amazing Race' format activities for student programs and teacher workshops/conferences.

Planning and then construction of the **QV Interactive STEM Garden**, designed by Ochre Landscape in partnership with the Quantum Victoria team began in 2017. This interactive space is a celebration of the human endeavour of Science, Technology, Engineering and



Mathematics throughout the ages, connecting students and teachers with the big ideas, people and formulae that have transformed our thinking and shaped the world in which we live. It has also increased the teaching and learning space of the Centre, connecting its audience with the twenty-four QR Codes, each depicting a letter from the Greek Alphabet and each delivering its own unique message.

The Centre met the target requirements for 2017 through the participation of over 7, 600 students from returning and new schools. We are committed to providing all students with access to our programs, in particular students from disadvantaged communities. This was reflected by the participation of 75% of the total number of students engaging in the Centre's programs from metropolitan disadvantaged and rural government schools. 2017 saw an increase in participation from Primary schools, making up just over 45% of the total student participation numbers. This is an increase of 3% from the previous year. There was an increase of 15% from the previous year of student participation from Year 7-10 bringing the student engagement to 50% and the remaining 5% coming from the VCE cohort. These figures reflect the Centre's focus on engaging and inspiring students in the Junior and Middle Years of schooling with the aim of increasing student participation in Science and Mathematics in the Senior Years and ultimately STEM pathways beyond school.

The Centre's commitment to building teacher and lab tech capabilities in the STEM disciplines was realised through the variety of teacher professional learning workshops and conferences delivered onsite and at external conferences. Details of these events are provided in the report.

2017 was an ambitious year, delivering many outcomes. I would like to conclude by acknowledging and thanking my talented team, our partners and the students and teachers who engaged in our programs throughout the year.



Soula Bennett
Director



Victoria's Science and Mathematics Specialist Centres Network

A unique model of STEM education

The Victorian Government has created a unique model of STEM education for schools by establishing a network of six Science and Mathematics Specialist Centres whose programs inspire inquiring minds and equip teachers with the pedagogy and resources to improve STEM learning.

Victoria's vision as the Education State demands the pursuit of excellence for every learner. It is important that young people, the next generation of innovators and entrepreneurs, are exposed to STEM-related careers and have the opportunity to practice 21st century STEM-related skills. Every week, through the Specialist Centres' onsite and outreach programs, thousands of Victorian students and teachers across the state from primary years to VCE are excited and educated by STEM as they:

- Use biotechnology to diagnose HPV infections
- Monitor astronauts' oxygen levels from the control room of a Mission to Mars
- Unlock the science and mathematics that gives elite athletes the competitive edge
- Examine biodiversity on the Western Volcanic Plains and the ecosystems of wetlands
- Design and print 3D objects to solve real-world problems
- Apply core sampling techniques to conduct a geological survey.

The Centres improve engagement and achievement in STEM by providing innovative student and teacher professional learning programs that encompass new and emerging scientific thinking, state of the art facilities, and cutting-edge technologies and resources – accessible to all Victorian primary and secondary students and teachers.



Profile

Quantum Victoria is co-located with Charles La Trobe P-12 College and delivers programs to students and teachers from Foundation (Prep) to Year 12. The Centre has positioned itself as a leader in STEM (Science, Technology, Engineering and Mathematics) Education.

Our Vision is:

'To cultivate curiosity and inspire creativity, motivating students and teachers to develop the capabilities needed in Science, Technology, Engineering and Mathematics to succeed.'

Our Mission is:

'Our diverse team works together to deliver an exciting, fully immersive experience that follows a highly effective, targeted approach to encourage excellence in Science, Technology, Engineering and Mathematics.'

Quantum Victoria builds the capacity of F -12 students and teachers in science, mathematics and digital technologies education across Victoria and beyond through:

- Increasing students' interest, participation and engagement in science and mathematics and digital technologies
- Encouraging more students to pursue career pathways in the STEM disciplines
- Expanding the knowledge base of teachers and building teacher capacity to engage students through innovative programs underpinned by the latest research and pedagogy.

Programs incorporate:

- Scientific Inquiry
- Design Thinking
- Building Resilience through Productive Failure
- Game-based Learning
- 3D Printing and Modelling
- Coding and Arduinos
- Gesture-based Computing
- Robotics and Engineering
- Alternate reality and Simulated experiences
- Scenario-based Challenges

'He who can no longer pause to wonder and stand rapt in awe, is as good as dead; his eyes are closed'.

Albert Einstein
(Theoretical Physicist)

Goals

The Centre's key goals reflect our mission.

Quantum Victoria provides access to all Victorian students with a focus on equity and a commitment to be at the forefront of emerging technologies. The Centre operates under the following five governance principles:

- **Excellence** through innovation, research, partnerships and contemporary pedagogy.
- **Integrity** underpinned by ethical practice.
- **Transparency** through a culture with clearly defined processes and protocols.
- **Equity and Access** for all Victorian students.
- **Accountability** through sound management of finances and resources.

Financial sustainability

The Centre receives approximately 98% of its annual revenue from the DET through the *Science Specialist Centre's Funding Model 2014-2016*. The remaining 5% is derived from additional funding sources (e.g. venue hire, partnerships and non-government and advantaged government school program charges). The DET Funding Model provides for the staffing (60%), resources (40%) and has a capped student attendance component and does not include funding for teacher professional learning. It is indexed annually in line with the CPI.

The Centre continues to meet the targets as set by the DET Funding Model.

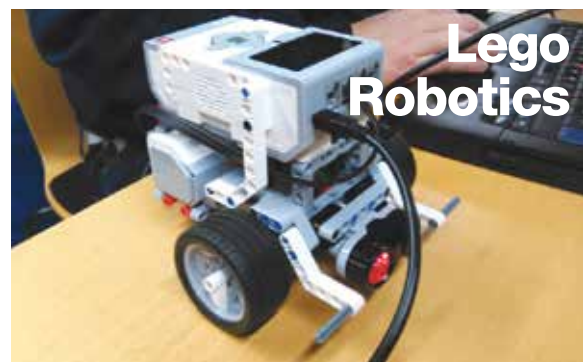
Governance and Accountability

The Centre's governance falls under the auspices of the Charles La Trobe P-12 School Council and complies with the DET's Specialist Science and Mathematics Centres' Memorandum of Understanding and Funding Model. The Director reports to the host school Principal and liaises with the host school Business Manager to ensure there is compliance with DET financial and management accountability protocols.

2017 Students Programs

Primary (F-6): 8 ONSITE Programs

| PROGRAM | YEAR LEVEL | DISCIPLINE |
|----------------------------------|------------|--|
| Exploring the Senses | F | Science, Critical Thinking Skills |
| QV Bean Story | 1-2 | Science, Mathematics, Critical Thinking (STEM) |
| Forces in Action | 1-2 | Physical Sciences, Biology, Mathematics (STEM) |
| Makey-Makey | 3-4 | STEM |
| Minibeasts | 3-4 | Science, Mathematics, Critical and Creative Thinking, Digital Technologies |
| Lego Robotics | 5-6 | STEM |
| Kinecting Sports and Mathematics | 5-6 | Mathematics |
| Minecraft | 5-6 | STEM |



2017 Students Programs

Secondary (7-12): 17 ONSITE Programs

| PROGRAM | YEAR LEVEL | DISCIPLINE |
|--------------------------------------|------------|---------------------------------------|
| Kinecting Sports and Mathematics | 7 | Mathematics |
| Lego Robotics | 7-9 | STEM |
| Code Breakers | 7-8 | Digi Tech, Mathematics |
| The Giant STEM Investigation | 7-8 | Biology, Chemistry, Mathematics, STEM |
| Programing with Arduinos | 7-10 | Digi Tech, STEM |
| Need for Speed | 7-10 | Physics, Digi Tech, Mathematics, STEM |
| PrintACar | 7-10 | Physics, Digi Tech, Mathematics, STEM |
| 3D Printing and Modelling | 7-10 | Digi Tech, Mathematics, STEM |
| QFI (Quantum Forensic Investigation) | | Biology, Chemistry, STEM |
| A Viral Enigma | 9-10 | Biology, STEM |
| Materials of the Future | 9-10 | Chemistry, STEM |
| Derive of the Dead –Math Methods | 11-12 | Mathematical Methods |
| Derive of the Dead –General Maths | 11-12 | General Mathematics |
| The Art of Chemistry | 10 - 11 | Chemistry |
| The Physics of Angry Birds | 11-12 | Physics |
| Respond to This | 12 | Unit 3 Biology |
| Nature Through Maths | 12 | Unit 3 Further Mathematics |



Data

Student Participation Data

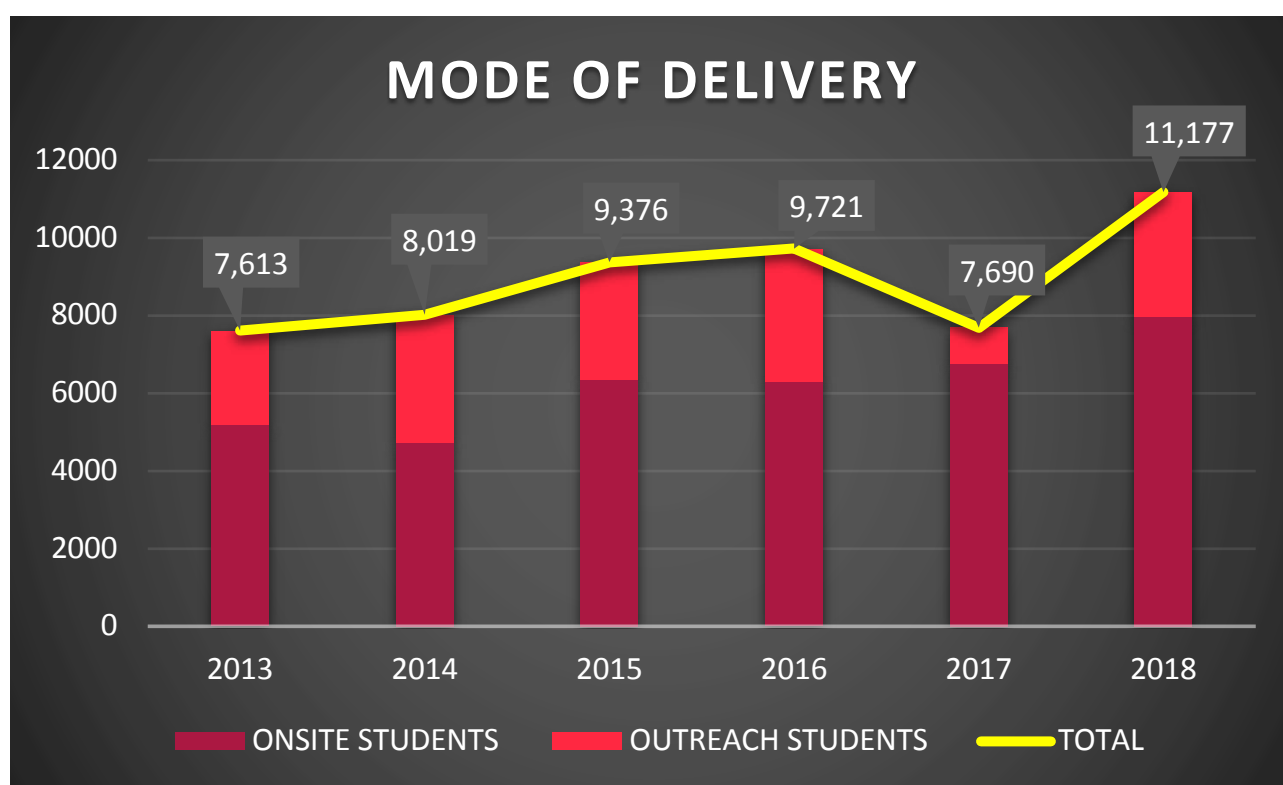


Figure 1: Student Participation Data: 2013 - 2017

The 2017 student participation targets reflected an increase in the onsite component of program delivery. Existing outreach programs required modification to reflect the Victorian Curriculum framework and the new VCE study designs. Human and physical resources were also invested in the development of the QV Online Portal (which will significantly increase our capacity to deliver outreach programs), Cyber Security and Women in STEM student programs and conferences, and teacher professional learning programs. A deliberate decision was made to focus on increasing our onsite programs in 2017, as we implemented our ambitious schedule for the year. These factors influenced our ability to deliver the outreach component of the student programs. Included in this graph is the Year to Date (1st August 2018) student data. The data to date indicates that the initiatives adopted in 2017 have increased student participation in both onsite and outreach programs in 2018.

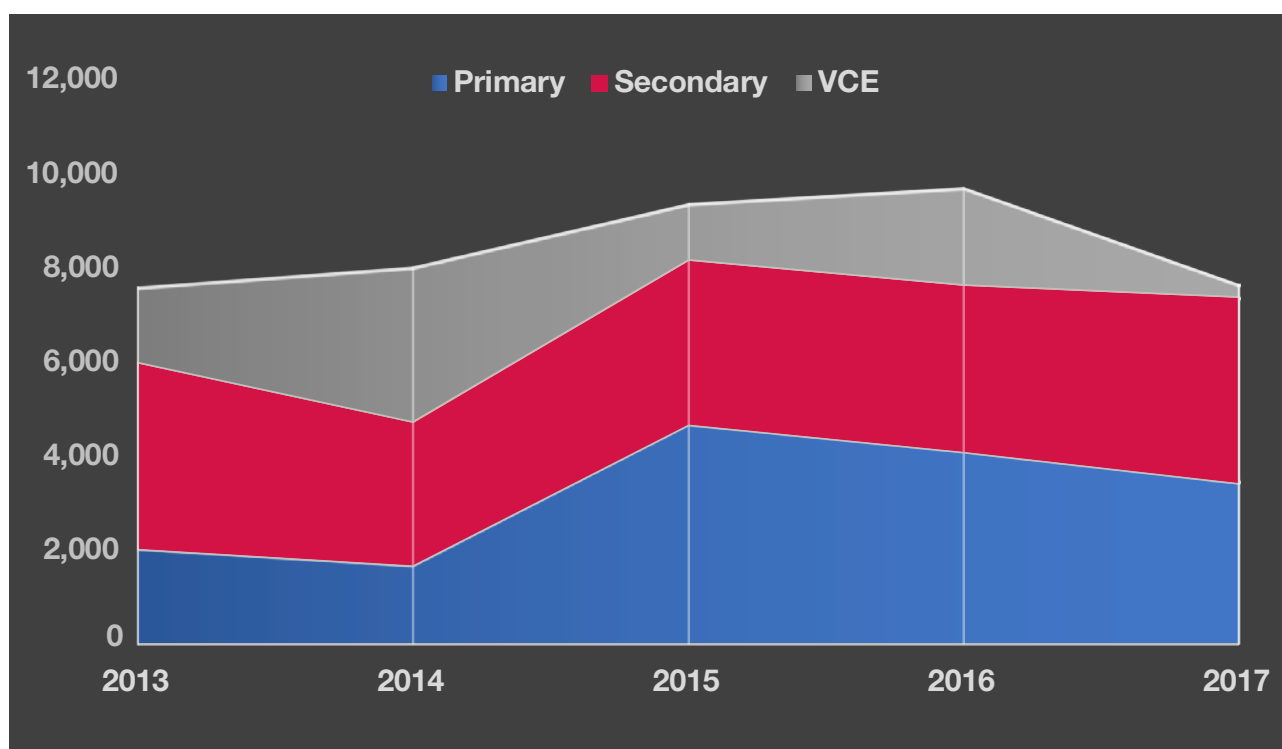
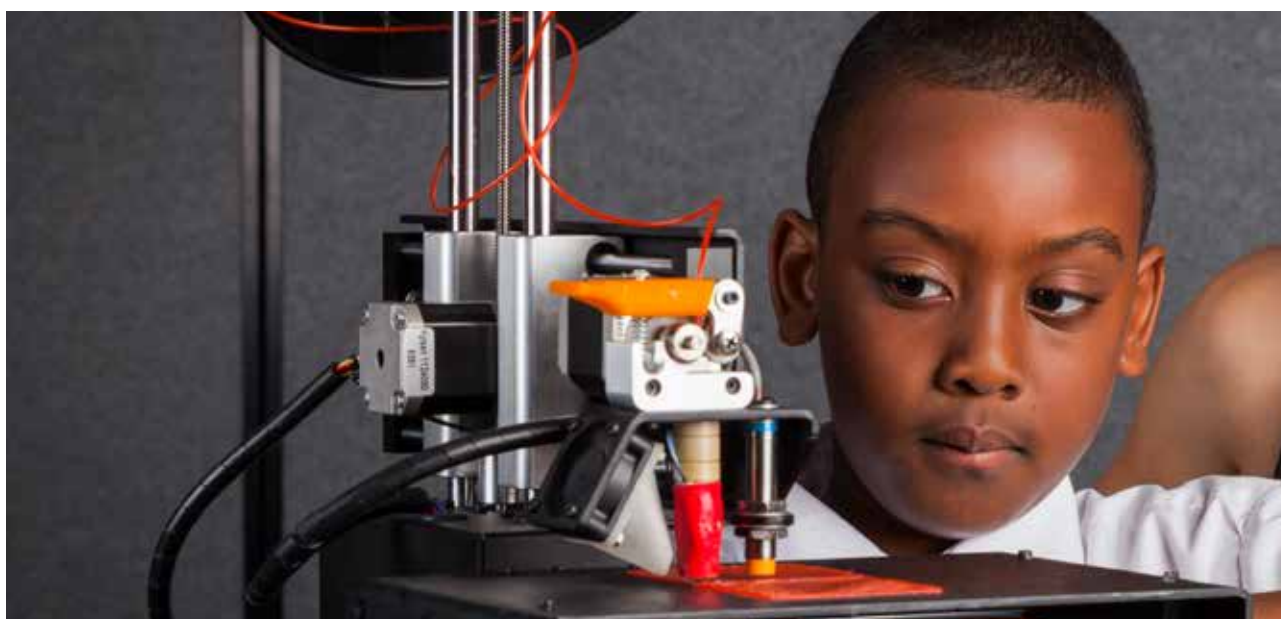


Figure 2: Student Demographics Data: 2013 – 2017

This graph illustrates the change in the targeted Year levels over the past five years. We see an intentional decline in the student participation in the senior years to provide more opportunities for primary and 7-10 secondary student engagement. This 'shift' in focus aligns with the Victorian Government's *Education State Agenda* and *STEM* aims. The increase in participation from primary and 7-10 secondary students may also be attributed to a greater awareness by teachers and schools of the Centre as a provider of STEM education and may also be an indication of an increase in the number of schools engaging in STEM programs and initiatives with their communities.



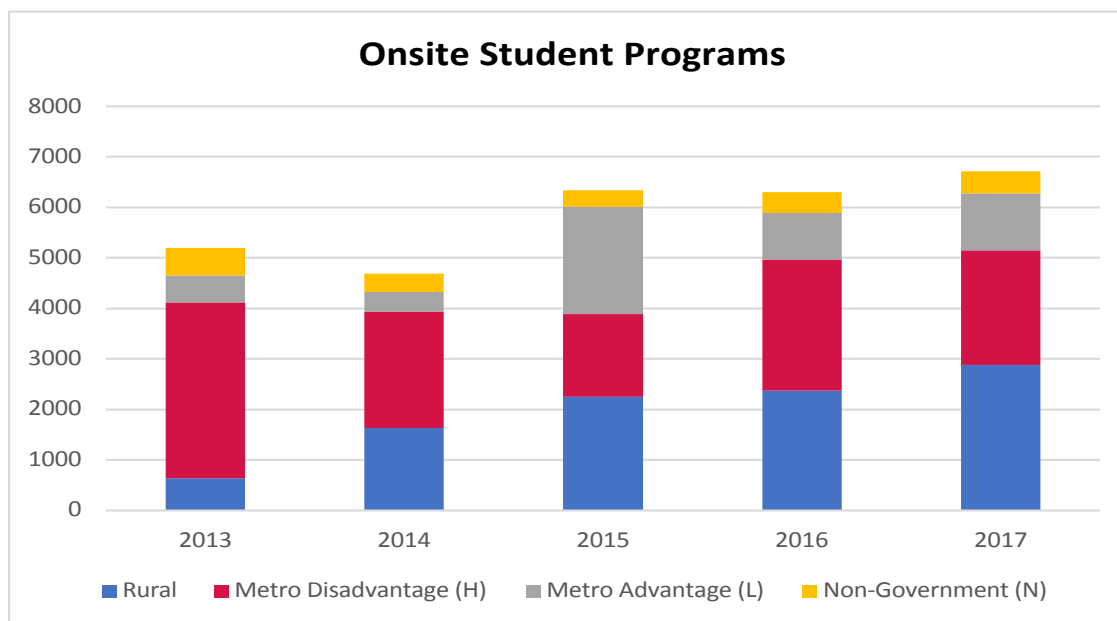


Figure 3: Mode of Delivery: Onsite 2013 – 2017

Figure 3 illustrates a steady increase in the number of students participating in onsite programs at Quantum Victoria over the past five years. There was 77% engagement by metro disadvantaged and rural government school students in our onsite programs. This exceeds the DET target of 75%. Student participation from advantaged government and the non-government sector aligns with the DET target of ~ 25% (actual: 23%).

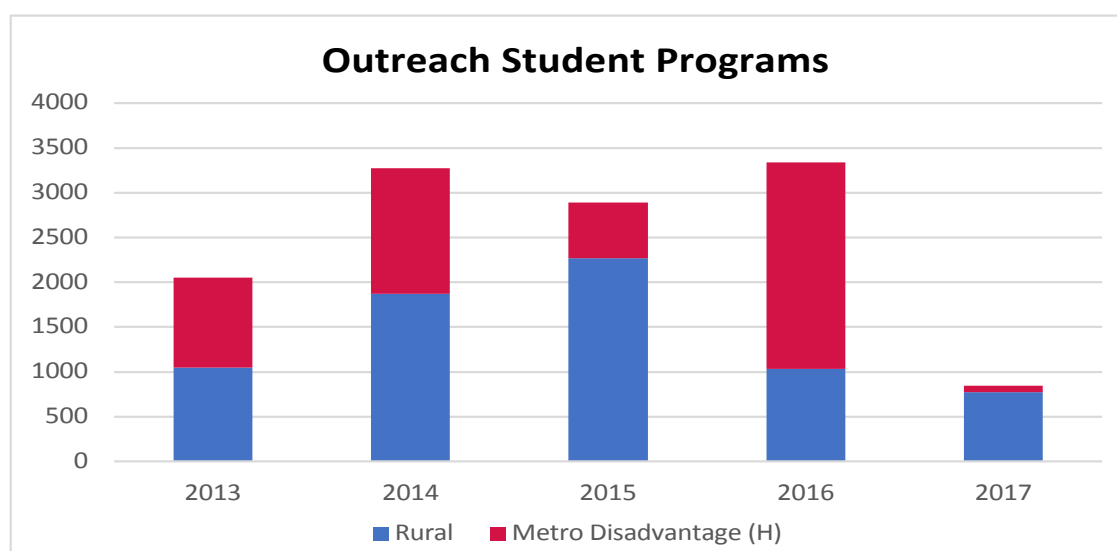


Figure 4: Mode of Delivery: Outreach 2013 – 2017

Figure 4 illustrates student participation by the cohort funded by the DET Funding Model for Outreach engagement; metro disadvantaged and rural government school students only. As discussed in Figure 1, the ambitious program development and initiatives schedule in 2017 impacted on our capacity to deliver Outreach.

Evaluating Quantum Victoria programs

The Likert scale was introduced in 2015 to record the student and teacher feedback through our exit surveys. The graphs below are an illustration of the total combined responses for all surveys. The format and survey questions were reviewed as per the Focus Group recommendations and minor changes were introduced mid June 2017 to reflect these.

The inclusion of 'gender' data capture and questions indicating an increased interest in Mathematics and Science were introduced. Questions linked to learning spaces, technology and activities were removed.

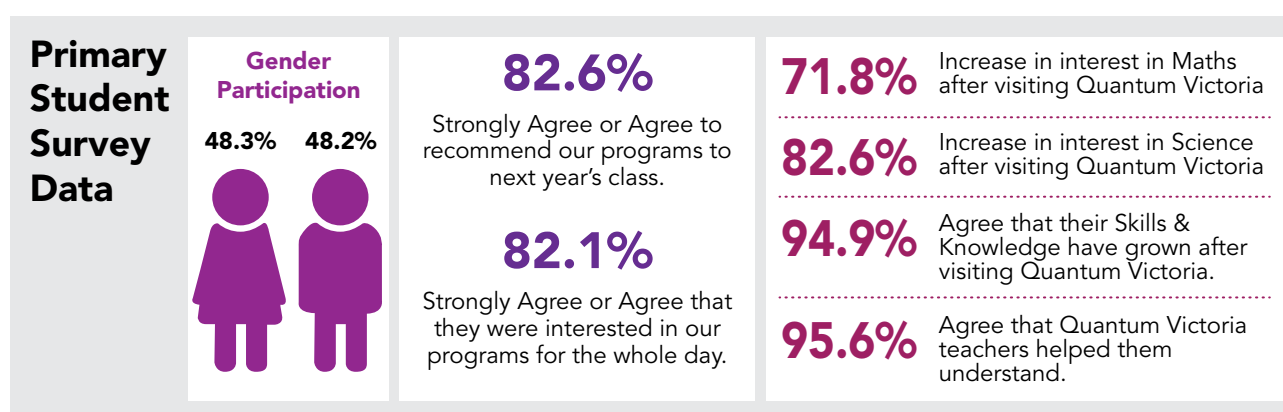


Figure 5: Primary Student Survey Data - 2017

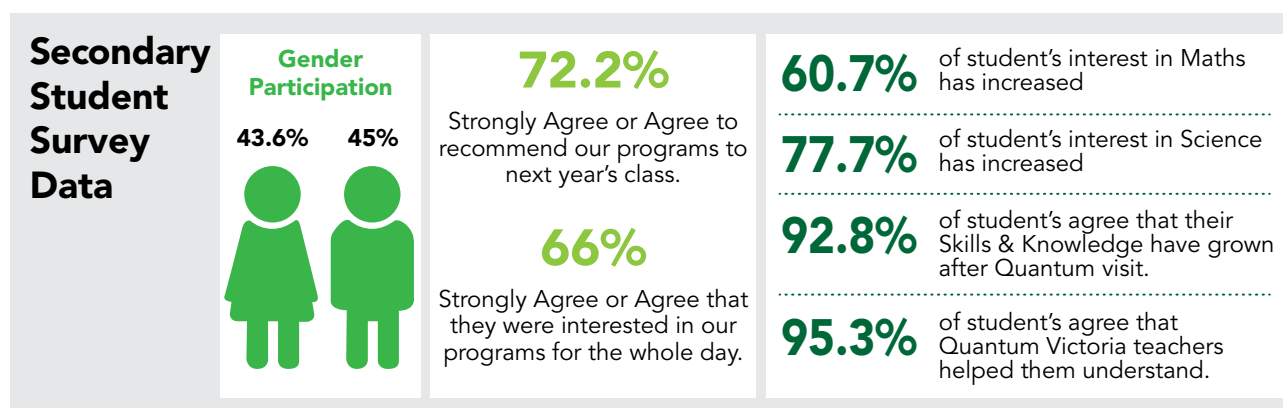


Figure 6: Secondary Student Survey Data - 2017

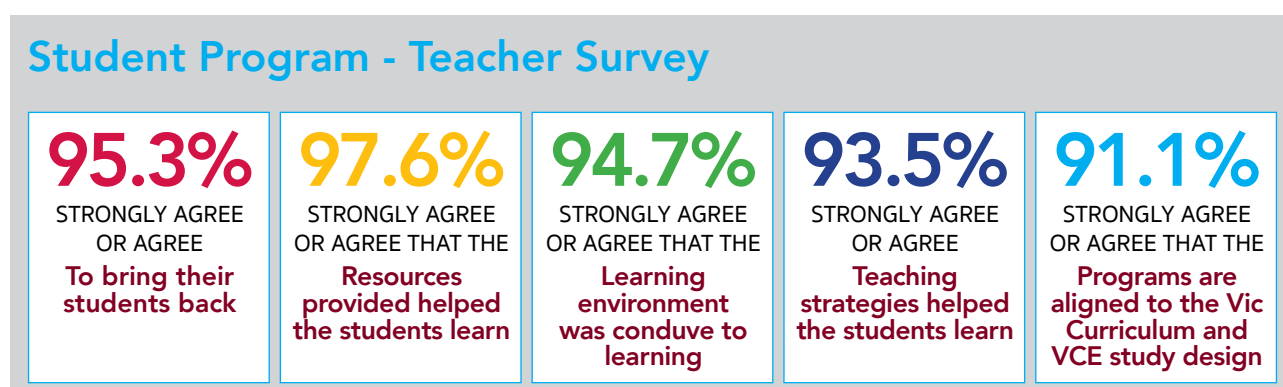


Figure 7: Student Program - Teacher Survey Data - 2017

Teacher Programs

The professional learning programs at Quantum Victoria are self-funded (not funded via the DET Funding Model) and target teachers from all sectors with a focus on Metro disadvantaged and Rural Government School teachers. The suite of Professional Learning activities build teacher capacity in STEM skills and knowledge through new, innovative forms of teacher professional learning. Our aim is to offer educators from all sectors a unique opportunity to re-envision their curriculum in ways that are relevant to today's learner, through workshops and conferences that are underpinned by robust, contemporary pedagogy.

Quantum Victoria Professional learning opportunities include:

- Best Practice Workshops
- 3D Printing and Modelling Experiences
- Coding and Digital Technologies
- STEM Pedagogy and Project Based Learning
- VCE Maths Workshops
- State wide Conferences in partnership with the Science Teachers' Association of Victoria (STAV): STEM Conference, Lab Tech Conference, VCE Psychology Workshop
- External STAV Conferences: VCE Biology, VCE Chemistry, VCE Physics, STAVCON

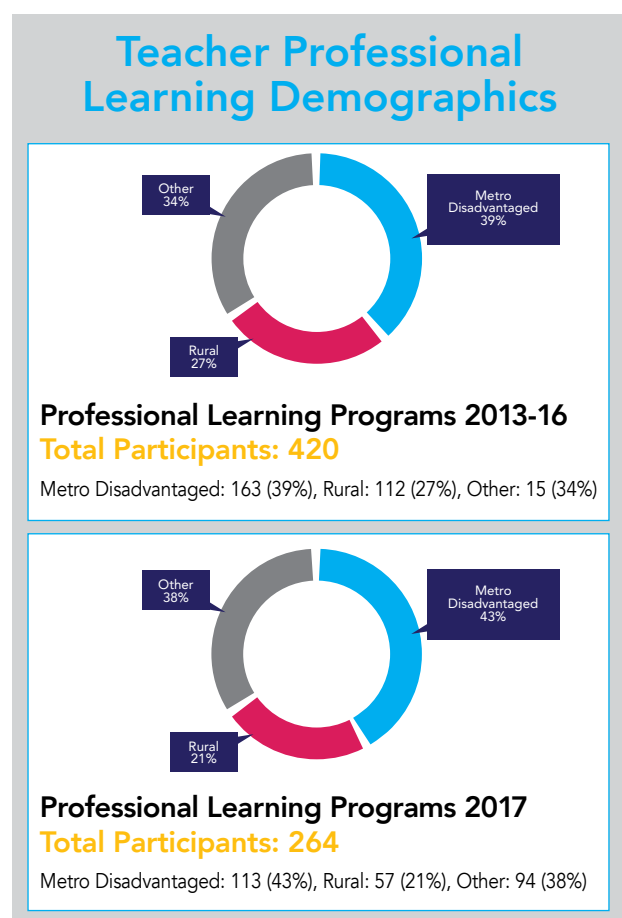


Figure 8: Teacher Professional Learning Demographics Data

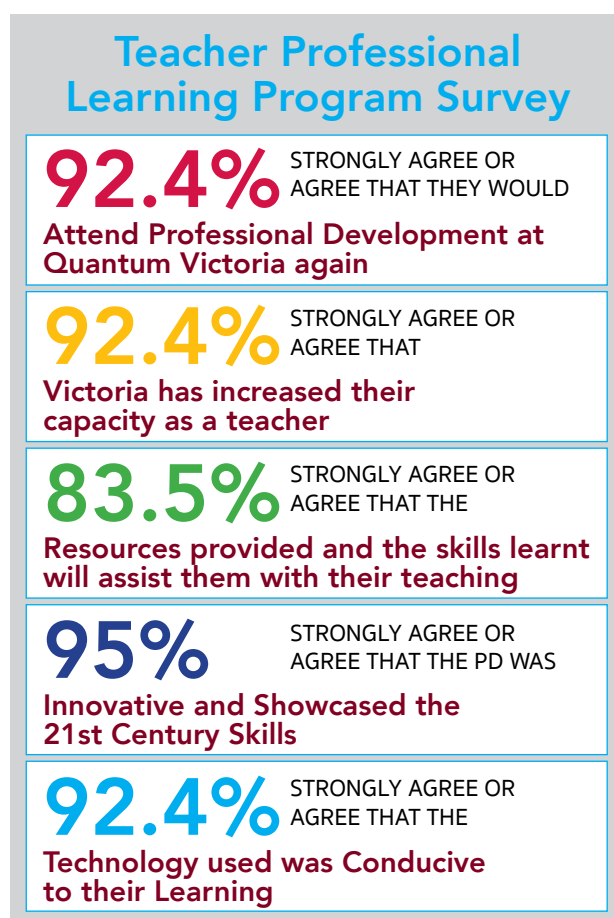


Figure 9: Teacher Professional Learning Survey – 2017

2017 Initiatives

1. Focus Group

A Focus Group of experts was enlisted from schools, government, industry and academia on the 2nd June in 2017. The purpose of the group was to offer feedback on the effectiveness of current practice and to suggest improvements and new initiatives that could be implemented in the future. Members of the Focus Group:

- Prof Bob Williamson, Chair, University of Melbourne, Australian Academy of Science
- Prof Bronwyn Fox, Factory of the Future, Swinburne University
- Prof Birgit Loch, Chair Teaching and Learning, La Trobe University
- Kate Parker, Department of Education and Training
- Anna Rigoni, Principal Charles La Trobe P-12 College
- Dr Marcus Zipper, Director CSIRO Services
- Dr David.E.Martin, Futurist, Melbourne Polytechnic

The report with the recommendations from the Focus Group is included as APPENDIX A.

2. Interactive QV STEM Garden

Ochre Landscape had the winning design for the space. The design team and builders worked closely with the Quantum Victoria team, resulting in the establishment of an interactive space that immerses its audience in the wonder and beauty of Science, Technology, Engineering and Mathematics. The STEM Garden is a celebration of the human endeavour that has led to the big ideas that have influenced our thinking and transformed the way we live.

The STEM Garden is realised through:

- Four vertical screens forming the backdrop representative of the STEM disciplines (Science, Technology, Engineering and Mathematics).
- Seating in the form of Einstein's iconic equation $E=mc^2$, allowing for a natural flow throughout the space.
- A shelter providing protection from the elements and comprised of 30 panels dedicated to a concept, equation, big idea, and/or scientists, mathematicians and inventors.
- The use of 24 QR Codes depicting a letter from the Greek Alphabet, commonly used in mathematical equations and scientific symbolism.
- A sophisticated space that invites and nurtures curiosity.





Interactive QV STEM Garden

3. QV Online Portal and Website

Quantum Victoria's long term vision is to provide a scalable outreach model accessible to students and teachers throughout Victorian and beyond. The result is an asynchronous learning tool comprised of 'Courses' that will complement onsite student and teacher programs and also provide 'stand-alone' Courses. The Quantum team worked closely with the developers, 'mitydigital' throughout 2017 and has begun to develop Courses to be trialled late 2018.

4. Women in STEM

A series of five **'Celebrating Women in STEM – STEM Capabilities for the 21st Century'** events were delivered across the year, showcasing role models for all students in different STEM disciplines. Over 500 students from metropolitan and rural government schools attended the events and were immersed in the following Quantum Victoria workshops: **'Coding and Arduinos'**, **'Additive Manufacturing'**, **'Advanced Materials'**, **'Robotics and Engineering'** and **'Cyber Security'**. The Keynotes were delivered by; **Dr Lesley Cheng (Biochemist)**, **Ms Kristin Lyons (Chief Information Security Officer)**, **Ms Rose Hiscock (Director Science Gallery)**, **Prof Bronwyn Fox (Chemical Engineer, Director of Factory of the Future)** and **Dr Leonie Walsh (Adviser in Technical Innovation and Industrial Chemist)**.

5. Cyber Security

The Quantum Victoria Cyber Security programs were developed to raise an awareness of the potential risks of sharing personal and professional data.

The programs aim to provide students with strategies to mitigate the identified risks through two student programs and the Cyber Games Challenge; the first of its kind in Australasia and in partnership with La Trobe University, Cisco and Optus.

The Primary (Year 5-6) Program; **'The Cyber Adventures of Aliya and Dimitri'** is delivered online and includes interactive games throughout each Chapter and the Secondary (Year 7-10); **'Quantum Cyber Investigation' or 'QCI'** is a Scenario based onsite program. The **'Cyber Games Challenge'** was developed for senior secondary students and attracted over 40 students from across the state with the winning team coming from Northcote High School.

The Centre's Cyber Security programs were launched during the second 'Women in STEM' Experience on Monday 29th May, with the keynote delivered by Ms Kristin Lyons, Chief Information Security Officer, Australia Post and attracted over 100 students and teachers from Victoria schools, representatives from universities, industry and State and Federal Government Advisors.

Rob Sloan, Wall St Journal Cyber Security Research Director, cited Quantum Victoria's Cyber Security Programs in his article on the 1st of June. His article is included in Appendix A.

Primary 5-6 Online Program: **'Cyber Adventures of Aliya and Dimitri'**

'Art of Play' were appointed to build the Online Interactive Story book. The first Chapter, **'Seriously Social'** raised the issues associated with posting private information on social media. Students and teachers navigated their way through the 'Cyber labyrinth' played out by our two protagonists, Aliya and Dimitri via a series of games. Trials commenced December 2017 with Year 5-6 Charles La Trobe P-12 students, teachers and parents and will continue in February 2018 with regional Victorian schools. Art of Play are also developing two more Chapters; **'Who's Who'** and **'Pesky Passwords'**. These will be completed in 2018 and trialled late 2018.



Secondary 7-10 Program: **'Quantum Cyber Investigation – QCI'**

The aim of the program is to inform students about the type of personal data that is being collected and stored about them through social media. The program takes the form of a Scenario where **'QuickVox'**, a new social media start up, has had their data compromised and has hired students as cyber security officers to help them find out who is stealing their data.'

Students use this information to build a profile on the QuickVox employees to determine which employee has compromised their data. This program was trialled in 2017. Students also explore examples of cyber security pathways and how to protect themselves from cyber-attacks such as phishing and malware.



6. Secondary student program 7-10: **Programming with Arduinos**

This program was developed in response to the Digital Technologies Curriculum in the Victorian Curriculum. Students use the knowledge and skills acquired to work towards creating a dexterity game with the use of LEDs, LDRs, potentiometers and an Arduino Uno.



This program immerses students in hands-on STEM education and develops 21st Century skills. Students need to think critically whilst programming and assembling hardware to solve real-world problems. A visual programming language; Snap4Arduino is used throughout the day. This program targets students from Year 7 to 10 with no prior programming and electronics knowledge.

The student program was complemented by the teacher professional learning program 'Coding and Arduinos', to ensure the teachers had the knowledge and skills to incorporate coding authentically into their curriculum.

Partnerships

Education, scientific, industry and community partnerships

Quantum Victoria has established many exciting partnerships, and continues to seek new partners who share our vision. Partnerships are both in-kind and financial and provide us with access to experts and cutting edge technology and research that enhance our programs and build the capacity of the Quantum Victoria team, visiting students and visiting teachers.

| PARTNERSHIP | NATURE |
|--|---|
| La Trobe University | PrintACar Final, Cyber Games Challenge, Cyber Security (Secondary), Engineering, Robotics, UniBridges and Pre-Service Teacher Placement. |
| Charles La Trobe P-12 College | Host School |
| University of Melbourne | Science Gallery |
| Cisco | Cyber Games Challenge |
| Optus | Cyber Games Challenge |
| Tall Poppies | Tall Poppy Events: Encouraging innovation and creativity through interactions between students and young researchers who have been recognized for their outstanding achievement in their area of expertise. |
| Science Teachers' Association of Victoria (STAV) | STEM, Science Leaders' and Lab Tech conferences |
| Centre for All-Sky Astrophysics (CAASTRO) | Telescopes in Schools and student outreach program development |
| Specialist Science and Mathematics Centres Network in Victoria | BioLAB, EarthEd, Ecolinc, GTAC, and VSSEC, a network of high quality statewide educational resources driving improved science and mathematics education outcomes in Victoria, working collaboratively to achieve this goal. |
| In2science Peer Mentoring | Statewide events utilizing the expertise of university students as peer mentors and role models in STEM disciplines. |
| LifeJourney | Cyber Security Master Class |



2018 Priorities

QV Online Portal

The migration and population of the QV Portal with student and teacher Courses will be a priority in 2018. The first student Courses will include a series of Unit 3 VCE Revision Tools for Biology, Chemistry, Physics, Further Mathematics and Mathematical Methods. These will be deployed in September 2018. The second will be teacher companion Courses for the face to face professional learning workshops and will be deployed from October -November 2018.

Cyber Security

Year 5/6 Primary Program: Interactive Online Story Book - The Cyber Adventures of Aliya and Dimitri, is currently under development with an external developer and will be completed by August 2018. Initial trials occurred in December 2017 and will continue throughout 2018. The Teacher Companion for the three Chapters; Seriously Social, Who's Who and Pesky Passwords will be available from October 2018.

Year 7-10 Secondary Program: Quantum Cyber Investigation- QCI will be available from July 2018.

Primary 3D Printing and Modelling Program

Quantum Victoria will develop a Primary 3D printing program in response to Primary schools incorporating 3D printing into their curriculum. The program will be available from October 2018.



Interactive QV STEM Garden

This learning space will complement the internal spaces and will be used to deliver activities associated with the QV Onsite programs including state wide events throughout 2018 and beyond.

2018 STEM Teacher Professional Learning

Quantum Victoria has received a Professional Learning Grant of \$100,000 from the Department of Education and Training (DET) to develop and deliver programs across the STEM disciplines in 2018. This will be via a blended (face to face and online) approach targeting teachers from government schools and will include workshops and courses in 3D Printing and Modelling, Coding and Arduinos, Deep Learning in Mathematics through Algorithmic Thinking and STEM Project Based Learning.

QV Marvel AVENGERS Experience

A series of four Experiences will be delivered during 2018 that will explore STEM through the AVENGERS' science fiction characters. Quantum Victoria has partnered with the Disney Group and has developed three workshops that focus on the 'super human' traits of the following AVENGERS characters; Hulk, Iron Man, Hawk Eye and Captain America. Students attending each event will rotate through the following workshops and activity;

- **'BioEngineering'** incorporating CRISPR Cas9 gene manipulation technology,
- **'Suit Up'** exploring characteristics of nano and smart materials and
- **'Aim High'** delving deeper into the scientific and mathematical concepts underpinning projectile motion.
- **'Build your own Super Hero Adventure'** utilising Quantum Victoria's QR Codes and game interface.

These onsite workshops will be available to Victorian metropolitan and rural students and will coincide with the Marvel AVENGERS Experience in Fed Square.

Data Capture

(a) Pre and Post Tests

Further development of Pre and post-tests for student programs will occur throughout 2018, building on the initial work conducted with our Lego Robotics Student Program. This program was chosen because it had the greatest number of bookings and spanned across four year levels; 5-8 and will assist us as we investigate strategies to measure the impact of our programs. The tests are designed to measure the 'value add' Quantum Victoria provides to each student. Data from the tests will be reviewed early 2018 and will inform the design of pre and post-tests for all Quantum Victoria programs.

(b) Review of Student and Teacher Surveys

A review of the existing student and teacher surveys will be conducted in 2018 and feedback will contribute to the development of the DET Evaluation Framework for all six Centres.

Articulating the Culture at Quantum Victoria

Gabby Ostragnay, Managing Director, 'Go People and Performance' will continue our work on articulating the Culture at Quantum Victoria, taking us into the next five years.

Quantum Victoria Team



Soula Bennett – Director

Soula is the President of the Science Teachers' Association of Victoria (STAV) and brings over 25 years of leadership and teaching experience in the Physical Sciences and Mathematics to her role as the Director of Quantum Victoria. She is currently a member of the In2science Peer Mentoring Board and is on the Advisory Board of the Centre of Excellence for All-Sky Astrophysics (CAASTRO) and contributes to STEM education policy both at the state and national level via committees, round-table discussions and forums.



Carlie Alexander – Teaching and Learning

Carlie is a P-12 graduate teacher who previously taught first year biology at the University of Melbourne. She completed a Master of Science (Marine Biology) at the University of Melbourne and her research involved determining the spread of introduced and invasive marine invertebrates and algae in a Marine National Park. She also completed a Bachelor of Science at the University of Melbourne, majoring in Marine Biology & Zoology. Other study areas included Chemistry, Earth Sciences & Botany.



Matthew Bliss – Education Officer

Matthew is an accomplished teacher at La Trobe University. He has completed a Bachelor of Science (Hons), majoring in Geology and was completing a Master of Science (Earth Science) at the University of Melbourne with his research involving the examination of the chemistry of volcanoes from along the Western Pacific Ocean, to better understand the processes involved in the formation of magma at these volcanoes. He has also engaged in work for Melbourne Zoo that has seen him travel to Kenya and Uganda.



Cress Byrne – Teaching and Learning

Cress is an expert teacher with over 15 years' experience in the teaching and learning of VCE Mathematics and Science. Her teaching methods include Specialist mathematics, Mathematical Methods, Further Mathematics, Physics, Chemistry and Biology. Cress has enjoyed a myriad of different roles in the teaching profession and brings this experience to the teaching and learning at Quantum Victoria.



David Feillafe – IT Systems Engineer

David is a network engineer, IT administrator, and software developer with a range of experiences in IT, management and teaching. He brings 10 years' of varied IT experience to his role at Quantum Victoria and oversees the ICT/AV infrastructure.



Yuvadee Patchon Lab Manager & Program Facilitator

Yuvadee has over 18 years' experience as a Laboratory Technician across both the University and School sectors and manages the Lab at Quantum Victoria. She also facilitates the delivery of student programs and is the Lab Tech representative on the Council of the Science Teachers' Association of Victoria (STAV).



Latha Shivasubramanian – Education Officer

Latha brings expertise in Engineering, Computer Science and Project Management to her role as Education Officer at Quantum Victoria. She has completed further study gaining her Master's degree in Astronomy and Astrophysics and her research project involved predicting the evolution of a binary star system using computer simulations. Latha is now able to share her passion for Science, Technology, Engineering and Mathematics with students and teachers attending the Centre.



David Smith – Programing and Game Developer

David is a game designer and computer programmer with Bachelors in Games Technology and Mathematics. Having tutored students from primary to university level, he bridges the gap between technical development and student learning. His main interests lie in programming and mathematics, focusing on how he can use game design theory to engage students in these areas and brings these skills to the Quantum Victoria team.



Mahaelia Thavarajah – Teaching and Learning

Mahaelia is a graduate teacher who is passionate about STEM education, predominantly, the disciplines of engineering and science. She has an interest in game-based learning and is keen to implement strategies that foster deeper learning in STEM for all students with a particular focus on primary students.



Joel Willis – Teaching and Learning

Joel is an accomplished teacher who previously completed a Bachelor of Nanotechnology/Bachelor of Science at La Trobe University. His undergraduate degree included physics, chemistry and mathematics which are supporting factors of nanotechnology. Joel has worked on both research projects at La Trobe University and in industry. His industry projects have been undertaken at DSTO, Dulux and Electromold.



Anna Ziogas – Administration Officer

Anna has over 27 years' experience in industry. Her roles have included Reception duties through to administration and the management of accounts. Anna's vast experience and excellent communication and interpersonal skills, gives her a great understanding of all office procedures and experience communicating with all stakeholders.

APPENDIX A:

Focus Group Report

June 2nd 2017

Quantum Victoria is one of six Specialist Science and Mathematics Centres established by the Victorian Department of Education and Training. It is embedded within Charles La Trobe P-12 College and has positioned itself as a leader of Science, Technology, Engineering and Mathematics (STEM) education both within Australia and internationally.

Quantum Victoria builds the capacity of both students and teachers in science and mathematics education across Victoria and beyond through:

- Increasing students' interest, participation and engagement in science and mathematics and encouraging more students to pursue careers in the STEM disciplines.
- Expanding the knowledge and inspiring teachers to engage students through our innovative programs underpinned by the latest research and pedagogy.

Programs embrace cutting edge, aspirational technologies and contemporary pedagogies with a particular focus on:

- Scientific Inquiry
- Game-based Learning
- 3D Printing and Modelling
- Coding and Arduinos
- Gesture-Based Computing
- Robotics and Engineering
- Virtual Reality and Simulated Experiences
- Scenario-based Challenges

A Focus Group comprised of experts from industry, academia, schools and government met on Friday June 2nd 2017 with the purpose of providing strategic direction on how Quantum Victoria can better fulfil its role as a Centre of Excellence and Innovation in STEM Education.

The accompanying report is a reflection of the discussion, feedback and recommendations made by the expert panel. Included in the report as Appendices is the Agenda of the Focus Group Meeting and a copy of the Wall St Journal Article featuring Quantum Victoria's suite of Cyber Security Programs.

Soula Bennett
Director, Quantum Victoria

Bob Williamson
Chair, University of Melbourne, Australian
Academy of Science

QUANTUM VICTORIA: FOCUS GROUP REPORT

An expert Focus Group was assembled by the Director of Quantum Victoria to offer views on the effectiveness of the current activities of the Centre, and to suggest improvements and new initiatives that could be implemented in future. The Focus Group is not a formal body with governance responsibilities, but an informal group of interested and committed individuals with knowledge of efforts to improve STEMM teaching and uptake, in Victoria and more widely.

Members of the Focus Group:

Bronwyn Fox, “Factory of the Future”, Swinburne University
Birgit Loch, Chair, Teaching and Learning, La Trobe University
David Martin, Futurist, Melbourne Polytechnic
Kate Parker, Department of Education and Training, Victoria
Anna Rigoni, Principal, Charles La Trobe P-12 College
Bob Williamson, University of Melbourne, Australian Academy of Science (Chair)
Marcus Zipper, Director, CSIRO Services
Attending: Soula Bennett, Director, Quantum Victoria

The focus group met at Quantum Victoria on Friday, June 2, 2017. We had access to a comprehensive report from the Director, Ms Soula Bennett, and heard presentations from Ms Bennett and three members of her staff. The program is provided at the end of this report. We thank the Quantum Victoria staff for offering an opportunity for the Focus Group to achieve a good understanding of the Centre, with full discussion which was always illuminating and at times critical.

This report has been prepared for the use of the Director and Staff of Quantum Victoria. We have tried to provide comments on the present activities of Quantum Victoria, and a framework for future initiatives and progress, that will also be of value to the Principal of the Host School and the State of Victoria Department of Education and Training.

CONCLUSIONS OF THE FOCUS GROUP

1. Three new Science and Mathematics Specialist Centres were established by the Victorian Department of Education and Training in 2011 - 2012, to complement the three existing Centres. Quantum Victoria (QV) was the last to start, in 2012. The Focus Group notes that this innovative approach by the Department, aiming to improve student engagement and achievement in Science and Mathematics, is even more important today than five years ago. Australia is falling further behind other countries, particularly in our region, in the numbers and the standards our students are achieving in STEMM (Science, Technology, Engineering, Mathematics and Medicine) subjects. This is particularly true for young women.

SUGGESTION: The Department of Education and Training should ensure that the roles of the specialist centres are preserved, and enhanced, because they can act as visible centres of excellence for the whole of Victoria. Their roles are quite different from those of the Tech Schools, and these two initiatives should be seen as complementary and each of great importance, and not as causing redundancy in any way.

2. For an educational organisation that is only five years old, the current activities of Quantum Victoria are very impressive indeed. The three modules that were described by staff (Lego Robotics, Cyber-security, Derive of the Dead) were each impressive, and one in particular (on cyber-security) has great potential for expansion. The quality of the modules is particularly impressive when put in context of the fact that every effort is made to ensure that access to Quantum is offered preferentially to schools with a low SE ranking. It is clear that, at least as well as can be assessed during a short visit, the morale of staff is very high, and there is a strong sense of an appropriate combination of leadership from Ms Bennett together with participation in planning by staff. The introduction of new modules such as cyber-security, which involves placing less emphasis on already successful modules such as 3D printing, is particularly praiseworthy. Quantum Victoria is meeting all current KPIs from the Department, is carrying out excellent teaching, is achieving very good to excellent results when assessed by students and teachers, and deserves every credit.

SUGGESTION: QV deserves high praise for its level of commitment and innovation, and clearly is valued by the teachers and students who use it. However, much of this depends on the inspirational leadership of the Director, and it is important that the Director continues to build the capacity of staff and expand the current leadership roles as part of a succession plan.

SUGGESTION: QV, while attempting to develop a more engaged and devolved leadership approach but retaining its drive and enthusiasm, should also determine, and perhaps record and discuss, with the Department and with the host school, its major KPIs both for short and long term planning. It is important that QV clearly articulates its core purposes and objectives, and the ways in which it is unique from the other Specialist Centres, the Tech Schools, and other STEMM education service providers. It is important that increased profile for QV results in a win/win situation with the host school, whose profile can also be raised in parallel.

SUGGESTION: For some modules, such as robotics and cyber-security, the ambitious

nature of the programs means that time should be allocated to ensure that updates (in collaboration with outside groups, including commercial and tech companies such as Google and/or Apple) can be provided and the material is up to date. The Department should consider ways in which QV can collaborate with commercial enterprises in an appropriate and ethical fashion.

3. The relationship between a “Science and Mathematics Specialist Centre” and its host school very much depends on a good relationship between the Director of the Centre and the Principal of the school. For QV, it is clear that this relationship is very good at present: the Principal appreciates the value of having QV at the College, and the Director appreciates the problems faced by the College, and does her best to help. The School Council is also involved, and clearly values QV. However, the Focus Group wonders whether this can always be assumed to be the case?

SUGGESTION: The Focus Group believes that there is a potential for great benefits were each of the Specialist Centres to be able to offer more of a State-wide role, which would be facilitated if Centres had more independence. The Department should consider whether a mechanism where policy and finance decisions could be made by the staff of each Centre, perhaps with guidance from a “Centre Council” and a representative from the Department, but with safeguards to ensure that close liaison with the Host School is still maintained. The Centres should form closer and more effective links with one another, might share resources and IT portals, and might consider developing a single, common strategic plan collaboratively.

4. The number of students who visit QV, approximately 10,000 per year, is impressive! However, considering the excellence of the subject matter, and the importance (identified both by State and Commonwealth Governments) of STEMM education, this is a small number compared to what one might hope for: at least five times this number. There does not seem to be a mechanism where success is rewarded with increased funding and space. It is important that the Department, and the State Government, demonstrates its pride in the successes of QV (and the other Centres) by active promotion of them, both within education and more widely.

Quantum Victoria has invested in the development of an Online Portal which will extend its reach across Victoria and beyond, thus providing opportunities for more students, teachers and pre-service teachers to engage in their programs. The Portal will be trialed mid-semester 2, 2017, and a marketing strategy will be developed to raise awareness of the Portal and to maximize participation. This will address the concern of not having the human and physical resources to cope with many more students, but raises another challenge, that QV will require support to develop and maintain online modules.

Given the large number of rural students, there could be activities that are targeted to rural areas, on issues faced by these regions. QV has entered into early discussions with the view of establishing a partnership with the newly established Regional STEM Centre in Wodonga, but as yet the partnership has not been formalized. To help to encourage young women to take greater interest in STEMM subjects, and to consider careers in science, female role models should be used wherever possible. This might include preparing short videos of female STEM researchers on the website showing that STEM can lead to socially useful jobs and interesting

careers for women.

SUGGESTION: The Directors of the Centres should prepare a “business plan” to put to the Department, listing innovative STEMM initiatives that could be offered for a small increase in funding. If the Centres cannot do this together, QV should do so in any case. It should be noted that these would include programs that are relevant to agriculture, forensics and new technologies such as mathematical genomics. The new subjects, which are interdisciplinary and often have a humanistic content, may be particularly oriented to increase participation of young women in STEMM subjects.

5. The focus group has already commented on the excellent quality of the work carried out by QV. This makes it all the more remarkable that QV is so little known in Victoria, even in educational circles. And yet, on the morning we met, there was a full feature article, perhaps running to 20 column-inches, in the Wall Street Journal on the program run by Quantum on cyber-security, hailing it as a world first and the sort of innovation that should be copied worldwide. It is a dilemma that much of the interesting, excellent work carried out by QV would be of great interest in the community, yet it does not get out there in the media. We suspect that even the Minister, and the Shadow Minister, are not aware of the excellence of the model that they have created and supported. Can this be changed? Is there room, in the system, for an Advisory Board to Quantum that could help with this, and with other priorities such as links with industry?

SUGGESTION: A KPI for Quantum, and for all of the Centres, should be ensuring that media coverage is given to the novel, interesting and innovative programs that are being covered. The Department, and successive Victorian Governments, deserve credit for these initiatives, and the centres should be offered training and assistance to be sure they are at ease with media presentations. It is possible that a volunteer media Board, whether for QV alone or for several centres, might be one mechanism to consider.

SUGGESTION: Reporting outcomes requires a more rigorous approach to assessment. Is the data collection as comprehensive and robust as it could be? One obvious gap is studying impact by gender. The QV experience should be seen as a research project, with data to be presented in academic forums and in education journals. To the extent that the six centres are unique in Australia, and in the world, the message should be spread, resulting in site visits from outside Victoria by interested parties.

6. The Focus Group noted that there is a theoretical possibility of much closer links with other resources, such as La Trobe University, which is a long walk or a short drive north of QV. Not only is this useful in principle (as La Trobe University has a long tradition of offering higher education to students who are disadvantaged), but it also would provide access to staff and students from La Trobe who would bring current research ideas and techniques that could demonstrate the importance of STEMM subjects for future employment. Education students are another potential resource. Closer links with La Trobe University could be used to help to provide opportunities for teacher professional development, perhaps of a more innovative type, for teachers at QV (something that should be funded in any case). Students from QV who show

exceptional interest or promise can be introduced to more advanced concepts through University links.

While we focused on links with Universities, an equally compelling argument can be made for closer links to industry, particularly as there is a CSL facility in Broadmeadows. There are also many resources available through CSIRO, which has a strong commitment to STEMM education in schools. Leveraging off these resources will help QV to move to the next, higher level of engagement with the STEMM community, and especially with a wide mix of educators and employers.

SUGGESTION: QV should develop and encourage closer links with Universities, with CSIRO, and with technology-oriented industry. The Department should consider funding these outreach efforts by funding an additional member of staff to facilitate outreach and the development of partnerships. QV might consider an approach for funding to the Ministers responsible for initiatives in innovation and biotechnology.

7. It is clear from the assessment reports that students who visit QV and spend a day studying one of the modules appreciate, and benefit from, the experience. However, there is minimal follow-up afterwards. We suggest that more emphasis is placed on retaining contact with the classroom science teachers from participating schools, with follow-up suggestions, study notes, and possibly further experiments for motivated students. In any case, all students should get certificates if they complete a module. Additional competitions should be considered to complement the existing Quantum Victoria PrintACar Challenge which attracts over 200 student entries across Victoria's Primary and Secondary schools and is now in its fourth year, and the most recent statewide cyber-security challenge in partnership with La Trobe University, Cisco and Optus. There are national competitions in areas such as robotics, and in app development. It may even be possible to consider an "advanced course" for a week during one holiday for the most motivated students, and/or a STEMM extension program embedded within the curriculum with the VCE students in the host school (Charles La Trobe P-12 College), where the time available allows attempts at more ambitious projects. It may even be possible to facilitate an intern program with CSIRO, tech or biotech, or University.

SUGGESTION: More attention should be given to pre-visit induction activities, and to post-visit continuing involvement. This should be considered for all students, but especially for the best and most committed students, as the international PISA and TIMSS data suggest that Australia does not accommodate the latter well. Links to University, industry and CSIRO would be important.

SUGGESTION: Quantum Victoria to consider whether there would be merit in appointing a QV Advisory Board, to meet three or four times per year, to offer on-going advice on policy and practice, and support with respect to external issues such as media and interactions with Universities, CSIRO and industry.

Professor Bob Williamson, AO, FRS, FAA, FRCP, FRCPath,
Honorary Professor, University of Melbourne

APPENDICES

1. Program for the day
2. Wall St Journal Article

APPENDIX 1:

FOCUS GROUP Friday 2nd June 2017 10 am – 2pm

| | | |
|-------------|------------------------|-----------------------|
| Attendance: | Bob Williamson (Chair) | UoM/AAS |
| | Birgit Loch | La Trobe University |
| | Anna Rigoni | Charles La Trobe |
| | | College |
| | Bronwyn Fox | Swinburne |
| | Soula Bennett | Quantum Victoria |
| | Marcus Zipper | CSIRO |
| | Kate Parker | DET |
| | David Martin | Melbourne Polytechnic |

AGENDA

| | | |
|---------------------|---|--|
| 10:00 am – 10:15 am | Introductions & Morning Tea | |
| 10:15 am – 10:35 am | Overview of Quantum Victoria | Soula Bennett |
| 10:35 am – 11:20 am | 3 x Presentations on QV Programs | Joel Willis Carlie Alexander David Smith |
| 11:20 am – 12:00 pm | Panel Discussion | |
| 12:00 pm – 12:45 pm | Lunch | Panel & Quantum Victoria Staff |
| 12:45 pm – 1:30 pm | Continuation of Panel Discussion | |
| 1:30 pm – 2:00 pm | Panel meets in private to discuss and Record suggestions and conclusions | |
| 2:00 pm | Close of meeting | |

APPENDIX 2:

Cyber Matters: Training the Next Generation of Security Experts

By Rob Sloan, cybersecurity research director, WSJ Pro

The logo for WSJ Pro Cybersecurity is centered on a dark, textured background. It features the letters "WSJ" in a large, white, serif font. To the right of "WSJ" is a gold-colored rectangular box containing the word "PRO" in a bold, black, sans-serif font. Below "WSJ PRO" is the word "CYBERSECURITY" in a gold-colored, serif font.

WSJ PRO CYBERSECURITY

Cyber Matters: Training the Next Generation of Security Experts

Published on June 1 2017

By Rob Sloan, cybersecurity research director, WSJ Pro

The shortage of skilled cybersecurity workers is a well-documented issue that affects government and private industry alike. The dearth of talent has caused salaries to soar and has left many small- to medium sized businesses priced out of the market and at a disadvantage when it comes to protecting critical data assets.

The problem does not start at university level though--many young minds have already discounted cybersecurity as a career choice long before that point. In particular, many female and minority students are turned off before college, further exacerbating the diversity issues in the information security industry.

Over the last few years, governments have started to address the problem and realized that talent must be nurtured from an early age. There are two key benefits to engaging students at K-12 level (roughly five to 17 years old): first, the student can get early exposure to how challenging and rewarding a career in cybersecurity can be; second it provides an opportunity to teach internet safety and security to young social media users.

Government funding for youth cybersecurity programs will never be at a level to reach every child though, and it is here that the private sector could make up the

shortfall through sponsorship and sharing expertise to develop content. Investment in cybersecurity education now could pay huge dividends in the future.

New Program Launched in Australia

This week, a new program aimed at school-age students launched in Australia and highlights the challenges of developing the cyber workforce of the future. Quantum Victoria is a Centre of Excellence and Innovation in Science, Technology, Engineering and Mathematics that encourages STEM subjects and introduces students to cybersecurity career paths.

Soula Bennett, director of Quantum Victoria, said: “It’s important to raise an awareness of the potential risks associated with disclosing personal information online” and added the Quantum Victoria cybersecurity programs have been customized “to incorporate everyday scenarios and situations that children can identify with and relate to so that they are able to recognize and mitigate the potential risks when confronted with these in real life.”

The curriculum for 10-11 year olds involves understanding the risk of sharing personal data, online identity and the importance of password security. One of the challenges of developing cybersecurity awareness at any age is communicating the messages. Quantum Victoria chose online animated storybook adventures with cartoon characters to hold the interest of younger children.

Older children can partake in scenario-based cyber investigations delivered onsite in schools and learn about phishing and malware. Students are put in the role of a cybersecurity officer at a social media company and charged with investigating the source of a leak. Ms. Bennett compared the exercises to a “cyber CSI”.

Quantum Victoria has partnered with other organizations such as LaTrobe University to provide access to experts and technology.

Promoting Women in STEM Subjects

Ms. Bennett said cybersecurity is a “burgeoning field in the STEM realm” and Quantum Victoria has actively promoted the involvement of women in the area through a series of ‘Women in STEM’ events aimed at 14-18 year olds and featuring female leaders in robotics and engineering and cybersecurity among others.

Australia is suffering from low supply of skilled cybersecurity labor and high demand from the banking and defense industries as well as government. The situation is made worse by some of the most talented individuals being recruited for overseas roles, particularly in Silicon Valley.

Australia is not alone. The U.S. National Security Agency and the National Science Foundation jointly fund summer camps for K-12 students. The 'GenCyber' program shares the aims of Quantum Victoria and are run by schools and universities nationwide at no cost to students. Similarly, 'Cyber Security Challenge UK' seeks to 'identify, inspire and enable more people to become cyber security professionals' through regular competitions, learning programs and networking initiatives.

Artificial intelligence will not be the silver bullet. If the shortfall in cyber expertise is to be addressed globally, we cannot expect improvement without investment. Private sector businesses associating themselves with programs now may see a return on their investment in five to 10 years' time when the current generation of students join the workforce.

(Rob Sloan is cybersecurity research director at WSJ Pro. Previously, Rob has worked as response director for a specialist IT security consultancy in London and built a team focused on detecting, investigating and protecting against cyber intrusions and responding to incidents, especially state-sponsored attacks. Rob started his career working for the U.K. government, looking at some of the earliest cyberattacks against the critical national infrastructure. Rob's main interest is the requirements, motivations and technical capabilities of threat actors.)







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