

# in alliance

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GIRLS' SCHOOLS AUSTRALASIA

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**COVER IMAGE**  
The Drone Academy at St Margaret's Anglican Girls School, Brisbane, provides a unique opportunity for students to be immersed in the engineering and science behind flying drones.



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ALLIANCE OF GIRLS  
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The Alliance of Girls' Schools Australasia is a not for profit organisation which advocates for and supports the distinctive work of girls' schools in their provision of unparalleled opportunities for girls.

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**QUESTIONS?**  
 Mark Walters  
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“ Through the support of World Challenge, I joined a group of senior leaders from the Alliance of Girls’ Schools Australasia on a ‘familiarisation’ trip. We came back with a good dose of perspective, an understanding of history, admiration for individuals who have devoted their energies to improving the lives of women and young people in very challenging circumstances, as well as appreciation for the preparation, care and ‘risk-management’ capability of World Challenge. Through this experience, we also got to know each other, and learnt so much about each other’s schools and leadership challenges. ”

**Fran Reddan**  
 Principal, Mentone Girls’ Grammar School (Melbourne)

## A BOLD AND EXCITING FUTURE ALLIANCE PRESIDENT

**T**welve months ago, the Alliance set in motion the planning process for our 2018-2022 Strategic Plan.

Our Executive Committee members have brought their individual and collective expertise and experience to bear on the development of this next strategic chapter. I thank them most sincerely for their passion, energy and commitment. We have had many hours of thinking, robust discussions, and done the difficult intellectual ‘heavy lifting’ that is required to take our organisation into the future. I believe our new strategic plan embraces all the very best of what has gone before with an exciting vision for the future.

After conducting a comprehensive review of the member surveys commissioned earlier this year, we had a thorough understanding of the expectations and perceptions of our members — principals and staff — as well as a quantitative measure of the extent to which the Alliance had met the goals of its current strategic plan. This analysis, supported by expert consultancy and the input of a number of important stakeholders, provoked and challenged the way we thought about our commitment to educating girls and what girls’ schools might look like in the future.

The framework for our 2018-2022 strategic plan centres on a renewed sense of purpose:

**We are our region’s leading voice for the education and empowerment of girls and young women. In collaboration with girls’ schools and key partners we strive for a world where more women make a difference in new and impactful ways, promoting inclusion and enhancing society.**

This purpose challenges us to aim higher and emboldens us to stake our claim as the peak body for girls’ schools in our region. It honours our expertise and collective knowledge about girls’ education and moves the strategic plan into its next logical iteration: a clear and compelling statement of the role of the Alliance in a complex and changing world. Importantly, our mission remains intact and focused on our first priority, our members:

**To advocate for and support the distinctive work of girls’ schools in their provision of unparalleled opportunities for girls and young women.**

Finally, guiding our initiatives and programs over the next five years are four principles:

- Harnessing voices
- Creating opportunities
- Inspiring girls
- Challenging convention

In the coming years, I believe that this new strategy will help fuel the motivation and energy we have to deliver new projects and opportunities that make a difference. This can only be possible with the support and involvement of our members and I thank you for your ongoing contributions. Together, we will continue to achieve great things for our schools and the education of the young women in our care. ▲

**FRAN REDDAN**

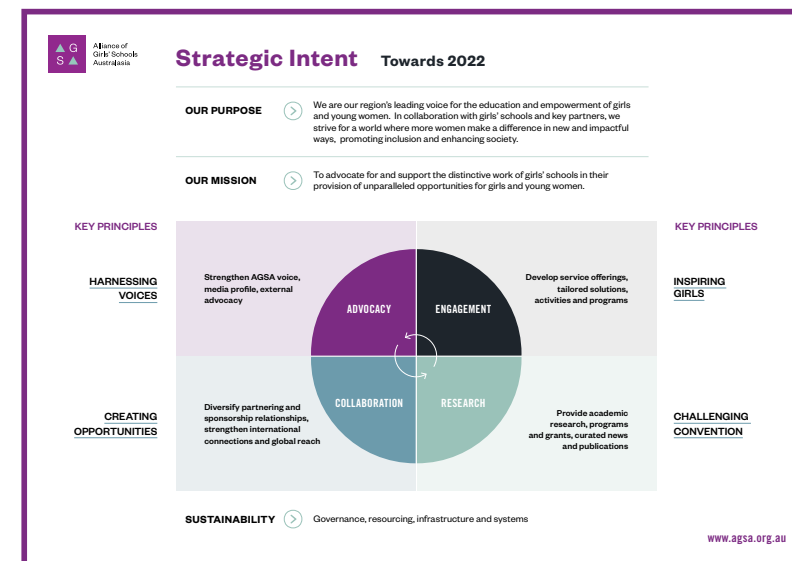


Image: Alliance Strategic Framework

## GENDER BIAS AND WORK FUTURES EXECUTIVE OFFICER

**W**ith so much uncertainty about the future of work and the skills our children will need for career and life success. How do we ensure they reach their potential, are prepared for the world after school and have the skills and confidence to secure their dream job?

Research into gender bias shows that girls as young as four years old perceive themselves to be less powerful than boys, and by the age of five children are well on their way to learning gender stereotypes. In high school girls are more likely to view their maths ability as “below average” and there’s a significant difference between girls’ and boys’ subject choices with fewer girls participating in STEM subjects (science, technology, engineering and mathematics). Last year a report released by Our Watch and Plan International Australia revealed that nine out of ten Australian girls don’t believe they’re treated equally to boys, just 14 per cent believe they have the same opportunities to succeed as boys and one in three agree with the statement “it’d be easier to get my dream job if I was a man”.

One of the major hurdles to boosting the number of women in senior leadership positions and STEM careers is giving girls the motivation, self-belief and resilience to disrupt gender bias. This is happening in girls’ schools where girls are more likely to reject gender stereotypes and are bucking the trend when it comes to studying STEM subjects. Girls’ schools are sending their students on to study business, law

and STEM degrees in record numbers — it is these areas that are touted as the lifeblood of emerging knowledge based industries and jobs of the future.

This issue of *In Alliance* looks at the incredible work our girls’ schools are doing to encourage and enable students to succeed in the workforce of the future. From integrating STEM initiatives as strategic priorities and partnering with businesses and universities on innovative programs to a research study that looked at students’ perceptions of the challenges they will face in the future and a principal’s opinion on what it means to be educated. Schools are well aware that the future world of work will be driven by technology, competition and globalisation.

From the tertiary perspective, we have key articles from QUT Professor Erica McWilliam who considers how to prepare students for an independent and creative future, and Bond University’s Director of Career Development, Kirsty Mitchell, who explains that ‘uncertainty management’ is the mindset required to thrive in the future.

I hope you’ll enjoy this edition of *In Alliance* and thank you to all our contributors for taking the time to share your expertise and practice, enthusiasm and innovation. ▲

LOREN BRIDGE

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## STEM-4-ALL: AVILA COLLEGE BRANCHES OUT AVILA COLLEGE, VICTORIA

**T**here has never been a more exciting time for STEM education in Australia. The National Education STEM strategy has seen the federal government commit 65 million dollars to enable teachers to access professional development and implement specialised STEM programs in the classroom (Australian Government, 2017).



session. Together students discussed how to develop a good focus question and hypothesis so they could write their own question for investigation. Before session two, the Year 8 students met with their assigned teacher to refine the focus question and talk through each group’s idea for their experiment. Session two focused on the introduction of the concept of variables and how they could be controlled and changed. It also concentrated on the difference between observations and inferences through conducting basic experiments with the primary school students. During this session, groups discussed and formalised the method and data collection for the inquiry question formed from session one.

During sessions three and four, the primary school students visited Avila College to conduct the experiments they had carefully planned in the preceding weeks. Students accessed the science laboratories and equipment — a learning environment that was new and engaging for the primary school students — expert staff and a range of outdoor areas to conduct their experiments. The atmosphere in these sessions was energised as students explored investigative questions

Similarly, the Victorian state government released the VicSTEM initiative in September 2016. Avila College has embraced this imperative with a particular emphasis on promoting female leadership in STEM through the launch of an innovative new program in partnership with primary schools. Designed to improve STEM competencies, consolidate learning through mentoring and enhance metacognitive thinking and communication skills, the STEM-4-ALL program teamed Year 8 and Grade 4 students together for an inquiry based seven-week program.

Funded through a grant from Catholic Education Melbourne, the student-centred learning program was developed by a core group of teachers from the Science and Mathematics departments. In line with the college motto, Inspiring Today for Tomorrow, seven session plans were devised with a focus on both curriculum content and establishing a meaningful mentoring relationship between secondary and primary school students.

Following an application and selection process, Avila College students travelled to the primary schools to meet their groups for an initial introductory

such as: What angle makes a rocket fly the furthest? At what temperature do different types of chocolate melt? And, how does heat affect a chemical reaction?

The final sessions focused on analysis as students discussed their data, drew conclusions, discussed limitations and finalised their findings. The project culminated in a presentation evening attended by parents and the school community where the groups displayed their investigations on posters and presented their findings to the audience. All students were formally recognised for their hard work and commitment to the program. Some of the comments from Year 8 students reflecting on their involvement in the program included, “I loved being a mentor”, “working collaboratively was fun!” and “I now have a different appreciation of science”.

Overall, approximately 180 students across five schools participated in the STEM-4-ALL project. Much of the recent literature around the success of STEM education programs focuses on key components such as: tailored and accessible, open ended, connecting with the real world, authentic, engaging and relevant (Chapman & Vivian, 2016). The STEM-4-ALL program succeeded in

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meeting these components because it was student led. Students, particularly girls, need to be provided with opportunities to be empowered, feel comfortable to question, experiment and lead in STEM. By structuring these safe environments, girls are more willing to try and experiment with STEM (Chapman & Vivian, 2016). While the program will be reviewed and further refined, Avila College is committed to providing authentic STEM opportunities that promote sustained engagement. ▲

KLARA BAKA  
DIRECTOR OF STUDIES YEAR 7–9

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## PREPARING THE NEXT GENERATION WORKFORCE: A SYSTEMATIC APPROACH

### CLAYFIELD COLLEGE, QUEENSLAND

**D**espite many positive shifts in perception and approaches in education, recent research suggests that uptake of STEM studies and careers among females is still lower than it should be.



Myths regarding the common issues are around awareness, attraction and retention. It is important that we, as educators and citizens are establishing the groundwork for a future in which “every job will be changed by automation over the next two decades” (Coady, 2017, p. 1). During the current decade, the

number of STEM occupations is projected to grow by 17 percent, compared to 9.8 percent growth for non-STEM occupations (Langdon, McKittrick, Beede, Khan & Doms, 2011). Beede, Julian, Langdon, McKittrick, Khan and Doms (2011) suggested that there is a great opportunity for girls to increase their representation across STEM careers, and this has the potential to greatly improve economies. The question then becomes how to best raise awareness of STEM opportunities at a school level.

Schools around Australia approach the learning area in different ways, with some offering a dedicated timetabled STEM subject, generally in middle years of schooling. The focus at Clayfield College is arguably more on the pedagogy and interconnectivity associated with STEM, with consideration given to authenticity and integration aspects. A cross-faculty approach highlight STEM, where the holistic focus is embedded into subject areas, as well as co-curricular projects, run both internally and externally. The implicit integration of STEM concepts within this approach creates rich and engaging experiences for the students.

It is difficult for teachers and departments to find ‘space’ within the day-to-day curricula. A focus on reaching out and building STEM community links has proven to be effective. Role models and dedicated extra-curricular projects have been crucial in raising awareness of STEM opportunities at Clayfield College. Studies show that female role models within STEM areas can greatly increase retention rates among girls (Prinsley, Beavis & Clifford-Hordacre, 2016), especially in culturally inclusive environments. Outreach to industry and university partnerships gives students exposure to the realities of STEM areas and dispels negative myths (Beede et al., 2011).

#### STEM at Clayfield

STEM, as a specific target area, was realised at Clayfield College in 2014, when a series of after-school workshops were developed. The program was christened *aCCelerate* (the uppercase Cs acting as a reference to the school’s initials), referring both to a physics concept and the philosophy of the program. Initially, *aCCelerate* involved high levels of input from a former student of the college who was studying engineering at The University of Queensland which undoubtedly enhanced the engagement levels of the participants. During the program, students were exposed to maths, science and technology concepts including force, pressure, surface area and 3D modelling. They used these concepts to design and 3D print an aesthetic and functional high heeled shoe.

An action research project examining the impact external expertise has on the engagement, motivation and interest of high-achieving students showed that the highest levels of engagement among student occurred when seminars or workshops were run by females in areas of interest; especially when there was an opportunity for practical ‘hands-on’ exercises. The findings substantiated the consensus of the literature;

namely that myth-busting and engagement with industry partners are crucial aspects of engaging students in STEM opportunities (Prinsley et al., 2016 Pricewaterhouse Cooper, 2015).

Our current STEM project, called *STEM2PLATE*, combines practical STEM activities with the dedicated purpose of supporting the Food Technology class. Again, the college has enlisted the assistance of a former student to help deliver the program and inspire the girls. The project is run with a focus on progressive elaboration and keen input from all students.

There have also been student-led initiatives such as *STEMAL Week* (the additional letters corresponding to ‘arts’ and ‘languages’ respectively) where former students were invited back to run small-scale talks and activities.

STEM awareness and engagement is improving across the college. Internal data showed that from the period of 2013 to 2016, Clayfield College graduate placements in STEM degrees across Queensland rose from 8 to 18 percent. Anecdotally, it is likely that the increase is due, at least in part, to the incentives provided by teaching staff and department heads across all relevant areas.

#### Into the Future

There is great scope for the future of STEM in the curriculum at Clayfield College. Continual professional development in addition to existing subject area expertise enables academic staff to integrate content and contexts to create authentic learning experiences and rigorous assessment instruments. Coupled with these attributes, building connections with university and industry through the broad College community will be a positive focus into the future. Attracting students to STEM pathways relies significantly on role models and outreach with external providers. ▲

JAMES LLOYD, CO-ORDINATOR OF LEARNING INNOVATION,  
LAKSHMI MOHAN, HEAD OF DEPARTMENT—SCIENCE AND  
TARA FRANKLIN, HEAD OF DEPARTMENT—CAREERS AND  
VOCATIONAL EDUCATION

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## FEEDING THE WORLD: A NEW AGRIBUSINESS COURSE

### COLUMBA COLLEGE, NEW ZEALAND



**C**olumba College has become a leader in girls’ STEM education, being one of the early schools to fully adopt a 1–1 bring your own device model (laptops) and adopting digital technologies as an essential learning area across all year levels and across the curriculum. This approach has enhanced learning and career development in the sciences, mathematics, robotics, design technology and computer sciences, with many Columba graduates going on to excel in these fields.

A new, less conventional curriculum innovation has been in the induction of Columba College as a Centre of Excellence School for Agricultural Science and Business, in association with brother school John McGlashan College. Through a new agribusiness course, delivered between the two campuses, we aim to encourage our graduates to pursue tertiary study and careers in the primary sector, up to and beyond the farm gate, recognising that innovation and change in primary industries will be essential to feed the world’s growing population.

In 2013 DairyNZ identified a major skills shortage in the agribusiness sector, with research showing that the industry needed 1250 tertiary qualified workers entering the field each year. The government’s target of doubling New Zealand’s primary sector exports by 2025 in itself will require around 25,000 more graduates, according to Ministry of Primary Industry (MPI) figures. However, less than 200 students graduated from university agribusiness related courses in 2013. By introducing an academically rigorous agribusiness course we aim for more of New Zealand’s brightest young minds

to become inspired by the opportunities available in this sector and realise that career prospects are numerous and diverse.

The Centre of Excellence course comprises four learning strands:

*Agri-innovation*, the study of innovative (bio) technologies and farm management practices that will ensure the future-proofing of primary industries in New Zealand (i.e. food safety, climate change, the globalisation of trade, loss of biodiversity)

*Agri-science*, the study of scientific principles related to agriculture and horticulture and the acquisition of scientific skills necessary to sustain and improve New Zealand's primary export products (food science, soil science and fertilizer chemistry, for example)

*Agri-management and finance*, the study of buying and selling within the primary sector, and the running of a successful agri business with regard to the market forces that influence supply and demand

*Agri-marketing*, the study of successfully and appropriately marketing primary products with reference to the target consumer, how to ensure one secures the best market value, and sustainability in the supply-demand chain

We launched the program in 2017 at Level 2. Students take six Level 2 subjects including Agribusiness, Mathematics, English and either Biology or Chemistry, or Accounting or Economics. Students are free to choose their remaining subjects from any of those offered by the college. There are natural connections to the study of languages, digital technology and design to enhance the agribusiness package for each individual student.

As well as course work there are opportunities for students to experience innovation, research and inspiration from the agricultural business and science community across our region of Otago. The University of Otago is a key partner, providing resources to encourage the students to continue in this field. Experiencing wine making from the field to the table was one successful field trip, and guest speakers from local innovators open the students' eyes to the possibilities for work in this field.

Our next steps are to negotiate holiday internships for our students with key business partners; to run an innovation hub to test the students' understanding of the thinking required to lead change in the industry; and to plan an overseas trip for the class to investigate agribusiness innovations offshore. The course will be offered at Level 3 from 2018.

As a girls' school located in the heart of New Zealand's rural sector we are ideally positioned to prepare our graduates for the changing needs of the rural workforce, and to lead innovation in feeding the world in the future, ethically and thoughtfully. ▲

JULIETTE HAYES, PRINCIPAL

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## INTEGRATING STEM LORETO KIRRIBILLI, NSW

The benefits of integrated STEM (science, technology, engineering and mathematics) understanding have been well established, with significant focus from analysts predicting such skills and education will shape business and the economy for years to come. For Australia, there is a downward trend against the OECD for employment of under 25 year olds in this domain (PwC Australia, 2015). Mathematics in particular is the potential driver for this trend, and the documented decline of student interest in higher, calculus-based mathematics is of major concern, especially as mathematics is critical to the development of STEM skills (Holmes, Gore, Smith, & Lloyd, 2017).



The impact for young girls is even greater; representation of females is significantly lower than males in both secondary school and tertiary level STEM courses. Providing girls with the inspiration for engaging and developing STEM based skills is complex, as it goes against traditionalist notions of education for young women. That said, the very foundation of Loreto Kirribilli speaks to the importance of engaging our girls in an education that prepares them for innovation and entrepreneurship.

To plan effective STEM initiatives, schools need to take a considered and organised approach, so the benefits of developing and implementing programs to support this growth are done in a way that is harmonious with current curricula offerings. We also need to balance the input and professional

development of staff, to ensure STEM integration is a consistent and incidental approach (Shernoff, Sinha, Bressler, & Ginsburg, 2017). Further, we need to provide inspiration for the girls at Loreto Kirribilli to be engaged and excited about the potential of STEM, and see how it can provide them with a rewarding future.

At Loreto Kirribilli, our primary initiative has been the integration of a Year 9 elective in STEM to be offered in 2017 for 2018 implementation. It will support established courses in science, technology and mathematics, whilst extending opportunities in engineering and integrating the concepts learnt in these courses. The course as it is currently shaped could include focus topics on collecting and storing energy, distribution of this energy and the technology behind battery production, developing mechatronic and robotic parts, using energy to conduct work, mechanical and robotic optimisation, programming and engineering, contemporary materials and the use of contemporary tools. These skills will culminate with a task implementing commerce and business concepts by providing an opportunity for students to create their own startup company, and deliver their idea and prototype product at a trade show toward the end of the year. There is a strong desire among the students to engage more with the ideals of STEM, particularly integrated learning experiences that bring concepts together.

Like many schools we have been offering co-curricular STEM opportunities, the most notable of which is STEAMPunk Girls (in collaboration with UTS) and a STEM Club. The STEAMPunk initiative was a program we entered into at the last minute, though it was easy to engage 16 Year 10 students who had previously expressed an interest in participating in more STEM based experiences. The pilot program is run through The Hatchery at UTS, and is being run with the vision to develop broader STEM programs in schools. It is part of ongoing research through UTS to understand the impact of STEM on young girls and provide resources to schools for developing their own initiatives. Thus far, it has been highly successful, with students working in their own time and in touchpoint sessions with UTS undergraduates and faculty to develop their ideas and deliver a solution to the big idea "Future Earth". Most of the projects focus on an area of sustainability, such as plastic bag usage or energy conservation, but the solutions are highly practical, visual and have the potential to create real impact amongst the community. The STEM Club run at the school is taking shape, and over the past term has focused mainly on programming and coding. As facilitators, we have been developing a program of activities including matchstick rockets, drones, robotics, mechatronics and aerospace tasks, just to name a few. The only hurdle we are to overcome is getting the time around all the other activities at the school! But with time and persistence, students will continue to engage. Into the future, we are also looking at engaging with VEX and FRC robotics.

The big picture is developing, and as the world moves further away from jobs that require people to complete rote tasks, even those seemingly too complex for machines and robots, students need to be equipped to respond to the trends. In support of this, schools and teachers all around Australia are racing to inject STEM programs into their schools, using a variety of platforms, experiences and activities to develop the necessary skills for students. At Loreto Kirribilli we are targeting girls exactly at the age that they disengage from STEM subjects with units of work that shift from discipline-specific skills into integrated and real world projects where their learning is applied. We are looking forward to seeing how the Year 9 STEM elective develops in 2018. ▲

JONATHAN MASCORELLA, TECHNOLOGY INNOVATION FACILITATOR

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## DYNAMIC CAREERS AND SKILLS PORTFOLIO: THRIVING IN A TECHNOLOGY RICH WORK FUTURE BOND UNIVERSITY, QUEENSLAND

The steady stream of research reports and media articles that predict significant loss and disruption in occupations as a result of automation and technology fail to identify the opportunities generated by the same drivers. The Oxford Martin School report, *The Future of Employment: How susceptible are jobs to computerisation* (Frey & Osborne, 2013) analysed 702 common occupations and found that up to 47 percent of these were exposed to automation.

McKinsey Global Institute's report *A Future That Works: Automation, Employment and Productivity* (Buglin et al., 2017) revealed the significant investment by large companies in artificial intelligence (AI) is between \$20-\$30 billion in research and development alone.

Martin Ford, futurist, in *The Rise of Robots*:

*Technology and Threat of a Jobless Future* (2015) predicts work that is routine in some way, predictable and repetitive is more likely to be automated when technology matures within industries. Conversely, work that is genuinely creative in nature (art, science discovery, business strategy), involves complex relationships with people (nursing, client facing roles) and highly unpredictable will be more resilient to automation.



The drivers of change are complex and not just based on advancements in technology. Climate change, economic fluctuations, aging populations in Western countries, a rising middle class in emerging economies and the changing aspirations of women are all significant factors. This broader context and resulting complexity make it impossible to determine the “safe” areas of work and industries as Ford’s automation criteria appear in all jobs. Instead, there needs to be a focus on exploring and reimagining work that is technologically transformed, enabling people to focus their contribution to higher end tasks involving complexity, creativity and problem solving.

The future world of work will be technology rich, globalised and competitive and this shift is occurring rapidly. While the rate of change will be unpredictable, this transitioning economy does not necessarily mean mass losses, but instead redeployment, retraining, and new opportunities. These shifts and changes can be overwhelming unless practical responses are developed to prepare future generations for this rapidly changing environment and vastly different career opportunities than those they have known. The imperative is not just individual but at a broader societal and economic level.

The mindset required to thrive in this future is one of uncertainty management — to be able to act within uncertain circumstances, with high levels of resilience in cycles of failure and learning with persistence. The same technologies emerging and impacting industries are also creating new platforms and ways to work that provide freedom, challenge and opportunity. Career paths emerging in this transformed economy are not of linear progression and development, but seemingly chaotic career

bursts of traditional employment, project work, self-employment, freelance contributions and the gig economy. McCrindle’s (2014) research predicts an average worker will have over five careers with up to 17 different jobs in their lifetime. This dynamic series of job transitions will be technology enabled with algorithm based application processes and technology platforms. For example, LinkedIn is the world’s largest database of professionals with a range of talent tools to support industry needs.

These transitions will require the skills of active career management to allow people to transfer skills and experience successfully. The Foundation for Young Australians report *The New Work Mindset* (2016) analysed more than 2.7 million job advertisements to reveal seven clusters of work in the Australian economy where skills are closely related and portable. That training for one job prepares candidates for up to another 13 roles by taking a broader view of work and the supply chain that surrounds it.

An essential skill is that of digital literacy: coding is viewed as this literacy tool that all students should be learning. Not only does coding provide a practical language for technology and source of direct employment opportunity, it teaches logical and complex problem solving, an understanding of user needs and confidence in technology more broadly.

Young people will require a flexible and adaptive portfolio of foundation skills in addition to various technical skills including the ability to collaborate in teams, communication and interpersonal skills, recognising patterns and an ability to explore and learn versus knowing.

Programs implemented at Bond University embrace this opportunity and support the development of adaptive skills through active exploration over the course of a degree. Beyond Bond is a compulsory program that focuses on professional development and community engagement while our Core Curriculum supports the development of foundational skills of critical thinking, communication, leadership and team dynamics and ethics. Our new Transformer Program is designed to support students to develop entrepreneurial skills and work in collaborative, interdisciplinary teams on challenging projects that enable them to innovatively tackle real world problems that matter. These programs and subjects provide students with a diverse range of practical experiences to explore the world of work, apply knowledge, and learn new skills. Soft skills development also builds on this adaptive and resilient approach.

*The New Work Smarts* report (2017) from the Foundation for Young Australians analysed over 20 billion hours of work undertaken in Australia to predict skills of value in 2030. They found that technology will free up workers from the manual elements of a job to focus on people, solve strategic problems and think creatively. They predict that

time spent on learning new skills on the job will increase by 30 percent, problem solving time will double, critical thinking and judgement will increase by 41 percent, maths and science skills application will increase by 71 percent, communication and interpersonal skills will increase by 17 percent and require an entrepreneurial mindset. Employers are leading this demand, with an increase in these skills as evidenced in the Future of Young Australians analysis of job advertisements, in particular entrepreneurial skills, digital skills (212 percent), critical thinking (158 percent), creativity (65 percent) and presentation skills (25 percent).

Tim O’Reily, founder of O’Reilly Media, highlights that Amazon’s business model of relentless focus on the customer experience has resulted in one of the leading examples of a technology enhanced business with the mix of productivity enhanced not just by growing numbers of robots, but also people, in addition to creating a depth and breadth of economic opportunity via the platform right through the supply chain.

The future of work is rapidly changing and full of opportunity, what is needed is an adaptive, flexible and resilient workforce. ▲

KIRSTY MITCHELL, DIRECTOR, CAREER DEVELOPMENT CENTRE

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## PREPARING TO THRIVE IN THE NEW WORK ORDER RUYTON GIRLS’ SCHOOL, VICTORIA

**T**hriving in the new work order will involve a new way of smart thinking. It means today’s young people need to become better problem solvers and communicators (...) and better at drawing on science, maths and technology knowledge.

[In 2030] workers will use the foundational skills of mathematics and science for nine hours a week (up 80 percent from today) and advanced technology skills for seven hours a week (also up 75 percent from today)”. (*Foundation for Young Australians 2017*).



At Ruyton Girls’ School we see preparing young women for this ‘new work order’ as an essential element of our learning programs across the school. While STEM has long been a core component of curriculum at Ruyton, we continue to develop innovative learning programs to further build capacity in our students to apply these essential skills in science, mathematics, engineering and technology.

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Several years ago, noted theoretical physicist, Stephen Hawking was quoted as saying “Whether you want to uncover the secrets of the universe, or you just want to pursue a career in the 21st century, basic computer programming is an essential skill to learn.” From an early age, Ruyton girls develop their coding skills through the Junior School STEM learning program Computational Thinking, where both the concepts and approaches of computational thinking are key components. Year 1 girls use the Boogie Bot app and the drag and drop language Blockly, arranging blocks of code to make their robot perform. Scratch Junior is used by Year 2 girls to design code. While not everyone of us will become a programmer in the future, it is important that our girls see where their strengths lie, especially in terms of the approaches needed to become a computational thinker. Students in Year 3 investigate, discuss and then nominate where their strengths lie in the five domains of the computational thinking approach: tinkering, creating, debugging, persevering and collaborating. While these domains are important elements of computational thinking, they are also essential life skills for the future ahead.

The capacity to apply skills across a range of disciplines and to work creatively and collaboratively are key elements of the new work order, and are further developed in senior school. In 2017 a multidisciplinary STEAM project has been developed and undertaken by Year 8 girls over a seven-week period. The project, called Making Music, crosses mathematics, science, music, and digital technologies. In Mathematics, students apply their learning about linear graphs and coordinate geometry to create equations from two randomly generated points using an Excel spreadsheet. Following this, they create an experimental, algorithmic musical sequence in C-Major using the randomly generated gradients and y-intercepts relating to the pitch and duration respectively. In Science, they will be experimenting with sound waves and how this relates to frequency and will also create a scale using glasses of water. The final compositions, utilising both regular musical instruments and musical water glasses, will be presented to the school community and a visiting musician as guest adjudicator. This project is only in its infancy but staff and students are already very excited about this opportunity for girls to apply their interdisciplinary learning to create and perform original pieces of music.

The Year 9/10 Creating the Future elective is a project-based elective designed to engage girls in cutting-edge, real world projects that involve applications of STEM. The course develops an understanding of various STEM fields and emerging technologies, focussing on knowledge, skills and understanding. The importance of creativity and critical thinking as problem solving strategies is emphasised. The core areas include biotechnology, with an emphasis on human

health and advancements in medical research; coding and app development as tools to help solve authentic problems of the 21st century; and digital manufacturing, engineering and design including 3D printing, augmented and virtual reality. Participants in this course engage and collaborate with experts in the wider community including local tertiary institutions and academics. During this elective students work on projects using the design-thinking model. Wherever possible the projects are authentic with the students presenting to a real audience or client they are working for. They must think creatively and work efficiently to complete projects by the set deadlines. Students are given very few parameters for what their projects ‘must’ contain, and teachers step out of the role of expert and into the role of facilitators. The relatively unstructured environment of the class fosters the development of important work skills, such as time management, working within teams, meeting deadlines and refinement of work using peer critique, and also encourages girls to take risks in their learning and their decision making. So far, students have developed a mindfulness colouring book, using mathematical sequences and series in nature to design the pages, and an educational board game based on biotechnology concepts. Their reflections following each project provided insight into the powerful learning they experienced, particularly around working effectively in teams and narrowing down broad lists of ideas during the design process. ▲

**CATHRYN FUREY**  
ASSISTANT PRINCIPAL, DIRECTOR OF LEARNING

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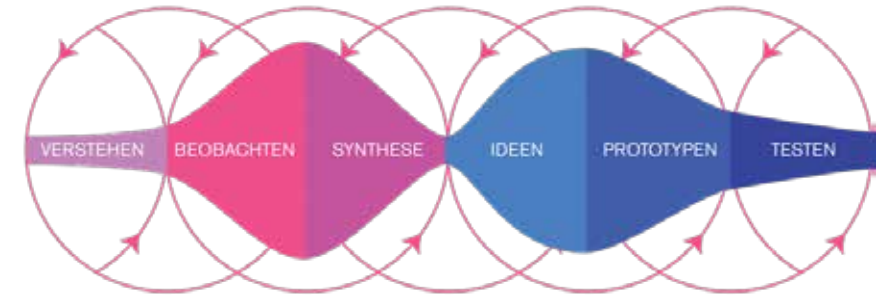
#### ACKNOWLEDGEMENTS:

I would like to thank the following Ruyton Girls' School staff who have contributed to this article: Tony Doyle (Junior School STEM teacher), Donna Moynagh (Senior School Mathematics teacher) and Subu Chockalingam (Senior School Science teacher).

## ONE SCHOOL'S JOURNEY ALL HALLOWS' SCHOOL, QUEENSLAND

In a culture of regular and continual curriculum evaluation against emerging needs, the movement away from a traditional Information, Communication and Technology (ICT) course has provided Year 8 students the opportunity to engage with a variety of STEAM units. However, after two years and further evaluation, another change is imminent.

**Figure 1.**  
**Design Thinking Process**



#### The Past

Before 2016, the Year 8 Information Communication Technology course focused on building knowledge and skills, incorporating elements of computer hardware, cybersafety, spreadsheeting, games and storytelling, 2D animation and visual design. In late 2015, coding with Scratch, MakeyMakey and LittleBits were explored within a new unit.

#### The Present

The Year 7 and Year 8 program was revisited in 2016, following the introduction of Year 7 into secondary school and our ongoing process of evaluation and renewal. The Year 8 ICT course was replaced with an innovative STEAM focussed transdisciplinary unit and a shift away from formal assessment. Collaboration and regular student feedback were incorporated to foster student risk-taking, group problem solving and the exploration of avenues of creativity and research. This contemporary program engages students as they rotate through four units, facilitated by teams of teachers who work collaboratively to plan and deliver the learning experiences. The units currently include: Food for Thought; Home Sweet Home; Marsbound and Patterns of Life.

Transdisciplinary in nature, the course extends beyond STEAM to include topics within business, civics, home economics and geography. Students engage in project-based learning as they explore real world, complex challenges and teachers embed instruction flexibly and in accordance with need, as opportunities arise. All units explicitly teach identified skills and attributes so that students can effectively participate in the workforce of the future — that is, the skills to be *future ready*; critical thinking, creative thinking, collaboration, communication, ICT skills and social and personal skills (QCAA, 2015).

#### The Future

Following the successful delivery of this contemporary program which has been readily embraced by teachers and students alike, the

school continues to review the unit in the context of emerging research regarding STEM and the under-representation of females; most notably in the STEM workforce in Australia as report by the Office of the Chief Scientist (2014):

... the importance of building awareness of STEM disciplines and STEM-related occupations among young people, an under-representation of females studying and working in STEM fields, and the importance of facilitating STEM partnerships between the education sector and industry.

In response to this multi-faceted direction, in 2018 four new units will provide students with opportunities to experience a range of STEAM careers and professions. Note that the lower-case a is deliberate. While each unit will focus on careers in science, technology, engineering or mathematics, all units will include an element of art.

There are three notable refinements to our future approach. Firstly, the refocus of the units to highlight STEM based careers allows us to connect to STEM professionals and experts in the wider community. Building career awareness through authentic engagement with professionals working in these fields will provide opportunities to connect students with role models and lead to the motivation to study and work in these areas.

Secondly, we will utilise the Design Thinking Process (Figure 1) as an approach to immerse students in the authentic working environment of each career. This approach encapsulates the transdisciplinary, project-based nature of the course while providing a practical framework around which students can explore complex challenges in a solutions-focused environment. The divergent and convergent thinking approach supports student problem solving and idea generation and the cyclical and iterative nature of the process allows for multiple perspectives to help generate innovative solutions (Scheer, Noweski, & Meinel, 2012).

Finally, our aim is to address elements of the two significant aspects of Marzano and Kendall's *New Taxonomy of Educational Objectives* (2007);

namely metacognition and self system thinking, to support the development of social and personal skills identified by QCAA (2015) and represented as a foundational aspect of the design of Queensland's revised suite of syllabus documents for the new system of Senior Assessment and Tertiary Entrance. Learning experiences that include specifying goals, process monitoring, examining importance, efficacy and motivation will be embedded in the project-based learning process.

These future focussed refinements represent a move away from what may be described as the teaching of ICT content, that is now the domain of all teachers as they implement the Australian Curriculum ICT General Capabilities. This innovative STEaM focussed course will provide an opportunity to implement engaging and stimulating learning experiences that address future societal needs, emerging trends in research and, ultimately, encourages our students to consider STEM related careers and prepares them for professions not yet imagined. ▲

DENISE SHUTTLEWOOD, ACTING HEAD OF TECHNOLOGY AND SCOTT ADAMSON, ACTING DEPUTY PRINCIPAL — CURRICULUM

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## OPTIMISM AND INNOVATION MELBOURNE GIRLS GRAMMAR, VICTORIA

According to The Foundation for Young Australians (FYA) and their New Work Order research, the automation, globalisation and flexibility of the future of work will ensure that a 15-year-old today will experience a 'portfolio career', potentially having 17 different jobs over five careers in their lifetime. They might be self-employed, working for other people or doing both — while also collaborating with people on the other side of the world.

This change isn't looming, it is here, it is happening. We can no longer look to the past to solve future problems as our future is rapidly evolving as is the workplace and traditional career.

At Melbourne Girls Grammar we are approaching these changes with optimism and innovation. Melbourne Girls Grammar is rising to the challenge of the future of work, by changing the traditional structure of schooling and providing opportunities for students to discover their passions and build their capacities for action and influence within their many life contexts.

For our students to flourish in the highly complex, accelerating world in which they will live and learn, they must emerge from school confident in their identity, equipped with strategies to expand their capacity to apply themselves in challenging contexts, and optimistic that they can create their own future opportunities.



IMAGE: YEAR 11 STUDENT WORKING ON HER ALGORITHMIC COURSE

The design of our Senior Years acknowledges the need for personalisation and the development of student autonomy within a defined structure and with clear expectations. Girls in the Senior Years have both fixed and flexible components to their week and have the capacity to shape their day according to the goals and priorities they have established with their teachers, wellbeing coaches and fitness coaches. Students are encouraged to develop solutions to problems that interest and engage them, harnessing their intellectual and creative potential.

A unique component of our Senior Years Program is Student Enterprise. Throughout their four-year senior experience, the girls engage with opportunities offered under the auspices of our Centre for Educational Enterprise (CEE). These experiences are organised under four domains: learning beyond school, careers inspiration, student philanthropy, and leadership. The girls choose from the suite of options and document their experiences and their learning in their Student Enterprise Profile.

As the girls construct their enterprise profile, they are also encouraged to develop broad

understandings of their place in the world and grow their intercultural understanding through participating in one of the global opportunities on offer. Girls are able to work collaboratively with our Student Enterprise Manager to create opportunities that help them investigate an area of interest and target their personal aspirations.

The learning beyond school component of the student enterprise offerings encourage girls to experience the world of work and inspire them to create a pathway to future career opportunities. These experiences take many forms and include but are not limited to the traditional notion of a work experience week. Careers Inspiration may include an online accreditation, an overseas experience or an internship. Our internship model has been developed to include extended experiences within a career field or a connection of workshop experiences that broaden their perspective of an industry or type of career.

In rising to the challenge of preparing students for the future of work, Melbourne Girls Grammar is creating the time and a diverse range of opportunities for students to build their understanding about their passions and talents and the types of skills, attributes and mindsets that will help them succeed and adapt to the future world of work, whatever that might look like. ▲

CHRIS MCNAMARA, DEPUTY PRINCIPAL, PROGRAM DESIGN AND DEVELOPMENT

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## IMAGINATION ... POSSIBILITIES, DREAMS, OPPORTUNITIES AND ADVENTURES

### MARIST SISTERS' COLLEGE, WOOLWICH, NSW

Two years ago a new course for Years 7 and 8 was introduced into the curriculum at Marist Sisters' College, Woolwich. The course aptly named IDEAS (Innovation...Design... Exploration...Achievement...Student-centred) allows students to delve into their imagination as they explore their learning.

The IDEAS course is an interdisciplinary approach involving science, technology, engineering and mathematics (STEM). It utilises the college's open learning spaces and is taught by a team of science, mathematics and technology teachers. IDEAS engages students in different real world projects to develop their

knowledge and skills in problem solving, collaboration, critical thinking, effective communication, adaptability, curiosity and discovery. These vital skills, already core to some workplaces, are essential in whatever career path students decide to take.

As a Mathematics teacher, with a desire to develop girls' interest and enthusiasm in mathematics, and knowing it was at school that my own passion was enhanced, these types of programs ensure that students delve deeper into life's core skills while also supporting their overall pattern of study. In an age where the number of girls opting to enter university courses in the areas of mathematics, science and engineering is decreasing, it is important that we instil in students a confidence and curiosity to explore their interests in these areas. And the impact has been positive with EV3 robotics and coding courses growing.

As part of our school-based course student curiosity and interest is explored in a number of real world projects. In Term 1, through the design process, students built a product to cushion an egg dropped from a height of two or more metres. An added challenge required students to modify their design with items selected from a mystery box. Working through the design process students analysed options, tested ideas, re-designed, applied research, evaluated and found solutions. Although at times a messy project, students had fun working in teams and sharing their final product with their peers and teachers. The ability to be flexible, think critically and not be afraid to test and make mistakes will equip our students with skills they will need for the future. As society faces an exponential increase of readily available information, technologies that are constantly changing, and more complex societal challenges such as global warming — work, learning, and citizenship in the 21st century will demand that we all know how to reason, analyse, weigh evidence and problem solve. "These are no longer skills that only the elites in a society must master; they are essential survival skills for all of us" (Wagner, 2014). Further projects to engage our MSCW IDEAS students include:

- Construction of the most effective catapult to knock down a set structure
- Design of a rocket that can travel a minimum height of five metres
- Design of a low-cost sustainable house following an emergency or disaster.

These projects call on students to investigate concepts such as angles, measurement, friction, mass, weight, geological forces, resource efficiency and environmental conditions in the design process. Student engagement in real life projects has been found to have very positive effects on their performance. Research by Weiss and Pasley (2004) found a direct correlation between students' learning and experiences with performance, particularly in mathematics. They also concluded that effective instruction emphasised student-centred learning that

was interactive and allowed for independent student investigation. The IDEAS course is focused on this approach to learning — students are hands-on and work cooperatively; it is these skills that will be needed in emerging workplaces.



Frey and Osborne (2017) support the findings of Weiss and Pasley (2004) adding that as “technology races ahead, low-skill workers will reallocate to tasks that are non-susceptible to computerisation — i.e., tasks requiring creative and social intelligence. For workers to win the race, however, they will have to acquire creative and social skills” (p. 45). It is for this reason that there is also a focus on group work as a strategy for problem solving in the IDEAS course. The way students learn to engage with each other and collaborate as part of a team to find solutions to real world problems, will equip them with skills for the future. Many workplaces today are set up as open plan, characterised by meeting hubs where employees are expected to interact and work together. Even bosses are part of these open plan spaces. This office setup and workplace style was adopted by Mark Zuckerberg, founder of Facebook, as described in *Time* magazine (Grossman, 2010). His focus on social interaction means workspaces are open plan devoid of cubicles, offices and walls.

Marist Sisters’ College is investigating ways to expand this school-based course into Year 9 in 2018. Based on student excitement and an appetite to test their designs, as well as the positive benefits of collaborative problem solving, this course is certainly challenging their imaginations and developing creative skills needed for the workplaces of the future. We are delighted to be involved in contemporary learning through our STEM course by using the IDEAS program. ▲

DR ANNE IRELAND, PRINCIPAL

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## IMAGINARIUM: LEARNING BEYOND THE CLASSROOM PERTH COLLEGE, WA

IMAGE: A KANGAROO AT CAVERSHAM WILDLIFE PARK GETS UP CLOSE TO AN IMAGINARIUM PARTICIPANT'S 'ANIMATRONICS' PROJECT



**G**ifted girls as young as seven are challenging their creativity and curiosity, asking big questions and developing skills for the future through a new programme at Perth College.

The School launched Imaginarium in 2017 to extend gifted students’ learning beyond the classroom and above their enrolled year level via a range of short courses.

The diversity of the programme has exposed participants to professions from art to engineering, promoting innovation, divergent thinking, collaboration and learning through hands-on experiences.

“Imaginarium is an opportunity for gifted girls to work with like-minded peers and flourish under an holistic programme that focuses on cognitive development,” Head of Imaginarium, Bek Duyckers, said.

“Our courses aren’t based on the curriculum or one particular learning area – instead, they are flexible and can be personalised, tailored to the girls’ passions and allow them to do things they won’t do in class.

“We focus on process, not the end product, so the girls learn to think critically and to be adaptive and flexible.

“We teach them to understand the meaning, and to consider the trends and the patterns of data

– this is paramount to the success of new ideas and innovations and will serve them well when they enter Senior School, go on to further studies and begin their careers.”

Ms Duyckers said each course, comprising 10 to 15 students, incorporated project-based, problem-based and perspective-based learning. Many of the courses include a STEM aspect although Imaginarium is not solely STEM focussed.

Some of the opportunities afforded to gifted girls through workshops have included:

- Combining robots with a love of animals; participants explored problems scientists face when observing the behaviour of animals and used robotics to create solutions. A visit to a wildlife park allowed the girls to use their equipment in the field.
- Exploring big questions driving innovation and future exploration of the universe; girls worked in small groups to find solutions to complex problems using robotics equipment, and visited the International Centre for Radio Astronomy Research.
- Working with a molecular biologist to learn how explorers uncover unique life, considering future possibilities using virtual simulation and robotics equipment.
- Exploring the physical principles of flight with an excursion to iFly Indoor Skydiving and a discussion with a Qantas engineer.
- Combining their passion for animals and art with a workshop run by a professional artist.

Courses that have run for the length of the term have enabled girls to:

- Employ futuristic thinking and collaborate in small teams to programme robots or code interactive games, creating solutions to complex challenges.
- Think outside the box about how they can create change as young global citizens.

“We want to encourage, motivate and stimulate the girls to really expand their minds and imaginations,” Ms Duyckers said.

“Gifted girls are often expected to know what to do, how to learn, and how to work through challenges.

“While they often complete their work in the classroom with ease, we know gifted students sometimes don’t have all the answers, particularly when facing a challenge.

“Through Imaginarium, the girls develop a toolkit of social and emotional strategies they can draw from when challenged; they learn failure is normal and to persevere, to recognise failure can often lead us to new opportunities we may not have dreamed of.

“The skills they build will extend into their lives,

leading to better functioning at developmental stages and critical life transitions.”

Several Old Girls have returned to Perth College to assist Imaginarium by mentoring high-potential and high-ability Year 5 students in the ‘Girl Guardians’ course.

“Research shows mentors are a positive and valuable addition in a gifted girl’s development,” Ms Duyckers said.

“Gifted girls are an incredibly diverse group and learn at a rate that is very different from their classmates, in accordance with their exceptional intellectual abilities.

“This can have ramifications for their social and emotional development and friendships, so sharing experiences with a like-minded adult who can provide intellectual stimulation, understand the girls and their needs, and share their time and skills has multiple benefits.”

Course participants met with their mentors each Tuesday evening during Term Two and part of Term Three to enjoy dinner before working on cognitive tasks.

The mentors listened actively and provided constructive feedback throughout each session. They also asked open-ended questions to encourage the girls to self-reflect and build on their ideas, referring back to their initial goals.

“It’s been fascinating to watch the growth of the girls during this course,” Ms Duyckers said.

“On a more personal level, they’ve gained an insight into our mentors’ lifestyles, careers and educational pathways, and opened their eyes to opportunities they may not have otherwise considered.

“There is a growing body of research to show girls achieve more when mentored and Girl Guardians has been a fantastic experience for each student to build character and perspective.”

Imaginarium is open to girls who attend other schools and has attracted enrolments from students in regional towns such as Northam and Margaret River.

For more information, visit the Facebook page (@imaginariumpertcollege) or the blog (<https://theimaginariumpertcollege.com/>). ▲

LAUREN UNDERHILL, COMMUNICATIONS MANAGER

## LEARNING FOR THE FUTURE LOURDES HILL COLLEGE, QUEENSLAND



In the face of today's economic, environmental and social challenges a relevant education is an imperative. Today's young people can meet future work challenges if their schooling and informal learning activities prepare them for adult roles as citizens, employees, managers, parents, volunteers, and entrepreneurs (Pellegrino & Hilton, 2012).

Lourdes Hill College (LHC) has long acknowledged the significance of the challenges ahead and the need to ensure that our students are well prepared for the challenges of the 21<sup>st</sup> century and life beyond school. In 2014, a research study tour and review of the literature by the Senior Deputy Principal — Head of School and Head of Senior School, Terry Niebling, set the foundation for future thinking and the investment in the college's new Centre for Innovation, Teaching Excellence and Leadership (CiTEL).

In order to guide our pedagogical approach to learning and teaching into the 21<sup>st</sup> century, we posed our school community the question: "What should learning and teaching look like in our classrooms of the future?" In 2016 CiTEL led a research study, the *Learning Futures Project*, to find some answers to this question (CiTEL, 2016).

The research methodology involved an extensive consultation process with the school community, including staff, students and parents, as well as with external learning experts. Data collection methods included online surveys, targeted focus groups and in-depth interviews with external learning leaders. The latter included a university dean, professors, digital strategy experts and representatives from the QCT, QCEC and QCAA.

The findings from the research (Buchan, 2016) have been used to inform the development of the school's new Learning Futures Framework and to guide strategic directions.

### Findings

The data gathered provided useful insights into how LHC can best prepare our students and staff for the future of work that they are likely to face. A snapshot of the findings is presented here.

*The perceived challenges facing students/staff into the future.* While the investigators' review of the literature and research made them highly conscious of the big picture informing future challenges facing students, it was a valuable exercise to hear the students' and parents' own perceptions of those challenges. There was general consistency between student and parent responses on the importance of the challenges. The most important agreed challenge was "Achieving to the best of their ability" with students ranking "Becoming financially independent" close behind. Those challenges that had a more immediate and personal impact on students, such as "Getting a job after school" and "Managing personal health" were highly rated. Lower on the list were issues with less immediate perceived impact, such as "Dealing with climate change", "Living sustainably" and "Dealing with world events."

The perceived challenges were analysed according to the patterns and themes which emerged from the combined data and fell broadly into the following categories:

- *External and future challenges:* Outside the school, becoming responsible citizens, getting a qualification and employment.
- *School and internal:* Achieving academically, managing day to day learning, learning how to learn from failing.
- *Personal challenges:* Health and wellbeing, anxiety and competition, achieving to the best of their ability, managing social relationships.
- *Family and friends:* Becoming socially aware and socially accepted and having relevant family support in their learning journey.
- Interwoven across all the challenges was the importance of developing social resilience.

Challenges identified by staff fell into the categories of personal and professional identity, personal health and wellbeing, classroom management, educational technology, and parents and teachers. The staff perceptions demonstrated positive acknowledgement of challenges and useful ideas were gathered around this theme.

In order to prepare students and staff for learning and teaching for the future, we sought answers to the following questions:

- What attributes, qualities and skills will our students need in order to prepare them for life outside of/after school?
- What do we need to know about preparing our students for tertiary study and/or the workplace?

Within the Lourdes Hill context, the desirable personal attributes and qualities included the following: learning to learn; citizenship; communication skills; resilience; personal values; achievement; know yourself, attitude/happiness and relationships. Students valued communication and relationship building skills as well as acquiring knowledge. There were particularly insightful comments from the students themselves about their own personal needs and attributes.

The external learning leaders gave insights into the changing nature of tertiary study modes, in particular blended learning approaches that students will encounter in whatever post-school training or study they take up. The qualities, attributes and skills that students will need in order to be prepared for post-school study and the future workforce are those which help to develop independent, self-motivated and resilient learners who can learn how to learn and are adaptable users of technology and the online environment for learning.

### Conclusion

The 2016 LHC Learning Futures Project afforded a unique opportunity to work with the college community to gain valuable and productive insights into the student, parent and staff experience of a Lourdes Hill College education. The project successfully gathered evidence and insights into the shared vision and aspirations of the college community that will underpin the implementation of our new LHC Learning Futures Framework to guide the student learning experience into the future. CiTEL will play an integral part in the implementation of the new Framework and in the design and delivery of professional learning programs to prepare staff for their roles in teaching in our classrooms of the future. ▲

DR JANET BUCHAN, DIRECTOR CITEL

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## SPACE SCHOOL: THE ULTIMATE STEM EXPERIENCE ACTURA AUSTRALIA

The future workplace will be an entirely different landscape to the workplace we know today and more so for low skilled positions. A Oxford University study estimated that 47 percent of jobs in the US are "at risk" of being automated in the next 20 years and will simply vanish due to computerisation and automation (Osbourne & Benedict, 2013). In 2013, the Office of the Chief Scientist of Australia (2013) identified that 75 percent of the fastest growing occupations in Australia require STEM related skills and an expected 50 percent of current jobs will disappear. This will leave a large segment of the working population under-skilled and looking for employment in a diminishing pool of available (for their skill set) jobs.

It's entirely possible that in 12 years' time when my kindergarten-aged daughter finishes high school, I will be waving goodbye as *the car drives her* to her final exams. As technology becomes more integrated into our lives, the less we see how powerful technology has become. Phones now have more computing power than the space rocket and modules that put men on the moon in 1969, we can access the majority of the world's learned information without getting off the couch and we can Facetime family and friends in different hemispheres communicating as though we were in the same suburb.

"I WANTED TO GO ON SPACE SCHOOL AS I HAVE ALWAYS HAD A PASSION FOR SCIENCE, SPACE AND ENGINEERING AND THUS I WANTED TO EXPLORE INTO THOSE DISCIPLINES. THE PROGRAM WAS A PERFECT OPPORTUNITY TO IGNITE MY PASSION FOR THESE THREE AREAS. I ALSO UNDERSTOOD HOW THIS OPPORTUNITY WOULD BE ONCE IN A LIFE TIME WHICH REALLY ENTICED ME TO PARTICIPATE." PAMELA – SANTA SABINA COLLEGE, NSW

All of this seamless technology comes from a finely tuned balance between state of the art hardware and the latest software (code) that makes the hardware run like it's intended. The future workplace will need educated, focussed, brilliant and bold people with insight and dedication to create the hardware and software that will drive future technology.

STEM, as it is commonly known, or science, technology, engineering and mathematics is the learning of these subjects in an interdisciplinary framework. Taught at all levels of primary and tertiary education STEM is increasingly being integrated alongside subject specific applications. STEM fosters and ignites creative and critical thinking — attributes that will be valued in the future



workplace. As we educate our children for jobs that do not yet exist we need to provide access to the tools and programs that will enable them to acquire transferable skills to meet the complexities that future workplaces will present.

Female students are underrepresented in STEM studies and even more so in STEM careers and particularly leadership roles. While girls perform academically as well as boys in their studies and in some cases better, they don't seem to be pursuing STEM careers. The Office of the Chief Scientist reported that out of the 2.3 million STEM qualified Australians only 16 percent are female (2016a) with the largest gender gap in engineering (2016b). That we need to encourage more girls and women to study STEM subjects and to pursue STEM related careers is an understatement.

**"THE SPACE SCHOOL WAS ONE OF THE BEST TRIPS I HAVE EVER GONE ON AND RECOMMEND TO ANYONE INTERESTED IN STEM. I HAVE MADE INCREDIBLE MEMORIES AND MET PEOPLE I WILL NEVER FORGET. I HAVE LEARNT SO MUCH, ENHANCING MY KNOWLEDGE OF STEM AND HOW TO BE SUCCESSFUL. THIS TRIP HAS REALLY INSPIRED ME TO TRY MY HARDEST IN EVERYTHING I DO TO ACHIEVE MY DREAMS AND GOALS."** SADIE – RAVENSWOOD SCHOOL FOR GIRLS, NSW

While learning and understanding STEM subjects in school may introduce some truly amazing experiences, often something extra is needed to get students' creativity and imagination really pinging. Undoubtedly, one of the world's most iconic science and technology establishments is the US space agency, NASA. And what better environment for young females to experience all things STEM related? American students have had the benefit of attending NASA Space School for many years, and since 2015 through a partnership between Actura Australia

and the Alliance of Girls' Schools Australasia this experience is now available to girls attending Alliance member schools.

Actura is the exclusive Australian partner of HASSE Space School International Study Program. This unique STEM learning solution is designed to empower students for life success within STEM related settings in one of the world's most profound and inspiring STEM environments — exposure to space exploration and science in conjunction with NASA.

**"I THOROUGHLY ENJOYED THE SPACE SCHOOL PROGRAM. I HAVE HAD AN AMAZING EXPERIENCE BY BEING PROVIDED WITH NUMEROUS OPPORTUNITIES AND LEARNING FASCINATING INFORMATION ON AREAS I AM EXTREMELY INTERESTED IN. I HAVE BECOME INFORMED ON A VARIETY OF ASPECTS OF SPACE ENGINEERING, SUCH AS CRYOGENICS AND THE TECHNOLOGY THAT IS BEING DEVELOPED FOR FUTURE MISSIONS TO MARS. I LOVED EVERY DAY OF SPACE SCHOOL AND I WILL REMEMBER IT FOR THE REST OF MY LIFE."** GEORGIA – LORETO KIRRIBILLI, NSW

The two-week Space School International Study Program is inspired by the *Seven Survival Skills* developed by Dr Tony Wagner, currently Harvard University's Expert in Residence in its Innovation Lab and a Senior Research Fellow at the Learning Policy Institute in California, and author Sean Covey's book *Seven Habits of Highly Effective Teens*. The program aims to empower students for rapid change, it expands the mind, encourages drive and instills curiosity within the context of exploration.

Students are immersed in enriched and exclusive space science activities at NASA's base in Houston Texas while they explore the multi-facets of STEM. They also learn and engage in an inspiring personal and leadership development program to prepare them for changing times.



Actura is focussed on supporting schools to empower their students with a comprehensive STEM experience that has an enduring legacy and may well ignite their passion for a STEM related career.

There are two expeditions running for two weeks each, one for junior students in Years 7, 8 and 9; and the second for senior students in Years 10, 11 and 12. Each expedition has its own unique activities and learning outcomes that provide students with critical life skills for personal success through hands on problem based learning, tied with immersive NASA coursework.

These programs provide opportunities to plant seeds in students' minds about STEM related career opportunities and not those of the stereotyped male scientist in a white lab coat mixing liquids in beakers. Female role models abound at NASA. The earlier the seeds are planted and nurtured the healthier the roots grow, spread and take hold. Girls' schools are tackling STEM learning head-on and extracurricular programs like Space School can provide the added advantage and encouragement for students to pursue STEM studies and careers. ▲

DANIELLE FLEGG, MARKETING COMMUNICATIONS SPECIALIST

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## RISING TO THE CHALLENGE: THE FUTURE OF WORK

### GENAZZANO FCJ COLLEGE, VICTORIA

In light of recent academic predictions that the future of our workforce will require highly-skilled and creative women, most notably in the realm of STEM, Genazzano FCJ College is directing a spotlight on this important and evolving profession.

The learning and teaching programs at Genazzano are designed to give our students the opportunity to grow, develop, and excel in all areas of their academic pursuits. The college believes that learning should be engaging, challenging, and above all, interesting. Students are encouraged to dream big, be confident in all that they do and, most importantly, allow their passion for learning to grow and develop at every opportunity. They are encouraged to view themselves as global citizens who are capable of generating extraordinary and world-changing ideas that can benefit communities across the globe.



Many current Genazzano students, and alumnae alike, are stepping out to embrace STEM studies with confidence, conscious of the high demands this important sector has to meet the most pressing environmental, sustainable, technological and health-related problems facing the world today. What the college has discovered is that when young women are supported to take calculated risks, true learning takes place. Together with tertiary organisations such as Monash University and Swinburne University, Genazzano students are forging careers within the landscape of STEM.

Three Genazzano graduates of 2016 (Carla Matthews, Stephanie Zago and Samantha Pereira) were recipients of the Monash University Engineering Scholarship, while alumnae Marielle Salom (2005) is currently undertaking a civil engineering/commerce double degree also at Monash University. Each of these young women agreed that it was the opportunity to rise to the challenge and step outside their comfort zones that attracted them to

the exciting and dynamic field of engineering. They were unanimous that the important value of self-confidence that they obtained at Genazzano, through their passionate, informed and motivational teachers, were driving forces behind their chosen career paths. STEM subjects bestow a conviction upon female students to feel empowered when entering the workforce with a specialised skill set.

Genazzano alumna, Laura Cantwell (2007) is one such woman that has applied her love of applied sciences and technology to the world of engineering, working as a structural engineer at the prestigious multinational ARUP firm in London. As Laura states, “With a career in engineering the opportunities are endless. In my type of engineering role, every day is different and every project has its challenges and problems to solve. You get to solve these with your fellow engineers, architects, contractors, developers, building surveyors and other consultants, and at the end you have a tangible product that has a widespread use for the community.”

This contribution to produce effective solutions to global issues and make a positive impact to lives and communities are key factors to why Genazzano students choose to undertake STEM studies. Recently, five Genazzano Year 10 students (Madeleine Ryan, Grace Burnes, Meimi Liu, Anna Frazer and Grace Tsao) were selected to participate in the 12 week Swinburne University BrainSTEM Innovation Mentoring Program with Professor Simon Moulton and PhD candidate, Shaun Geitman. The students presented their original innovation at the BrainSTEM Innovation evening at Swinburne University in June. Their creation, the ‘Sugar Straw’, resolves to reduce sugar in commercially available drinks, thereby making them healthier to consume. The students successfully utilised activated charcoal to remove 86 percent of glucose from water, and they designed a straw prototype.

This was an opportunity for students to partner with a world-leading organisation to experience real world learning of STEM, and the Year 10 students’ team project and presentation was so impressive that they were invited to present at the 4th Annual STEM Education Conference in Sydney.

As Year 10 student Anna Fraser recounts, “Our team of five students — aspiring scientists, mathematicians and engineers — have brainstormed and developed an idea to help the community. This whole process of evolving our ‘Sugar Straw’ to its current proven concept has enlightened us as to what it takes for a career or degree in the STEM fields. It has certainly instilled an excitement in me about the possibility of studying STEM in the near future.”

Anna’s team mate and fellow Year 10 student, Grace Tsao, agreed that a change in attitude about what can be achieved was important for their success. “BrainSTEM has been a once in a lifetime experience. Through this program, in which my

team and I endeavoured to remove glucose from a solution, I have learned that in order to solve certain issues, we must motivate ourselves to think out of the box and challenge the impossible.”

STEM is an opportunity for young women to pursue a career where they are encouraged to unlock their potential in a constantly evolving and exciting field. Genazzano is proud to be able to present multiple platforms in which our students and future alumnae can be a part of an empowered workforce that works towards a more intelligent and sustainable planet. ▲

LARA ANTONELLI-LEORKE, DEVELOPMENT CO-ORDINATOR

## INSPIRING GIRLS IN MATHEMATICS PLC SYDNEY, NSW

**M**athematics at PLC Sydney makes connections through universities and fosters a growth mindset through varying incursions and enrichment.

Dr Lloyd Dawe, is PLC Sydney’s Mathematician-in-Residence. He recently published an article in *The Australian Mathematics Teacher* that tells the PLC story of creating a rich environment of challenge where students are encouraged to engage with mathematics material that requires them to struggle with concepts that go beyond the syllabus.

Our enrichment program begins in the junior school in Year 4. Secondary staff are allocated to teach alongside primary staff as a regular part of their teaching duties. We use the materials produced by Australian Maths Trust, and various national and international competitions, to teach the girls how to start thinking about a maths problem. Dr Lloyd works with Years 5 to 11 and staff to develop lessons beyond the curriculum. In Year 7, students are selected from parallel classes based on their interest, but there is a top class (intended for eventual acceleration) and a second class. The focus on the top two classes continues in Years 8 – 9. In these years students continue to experience maths concepts beyond the curriculum to further develop higher order mathematical thinking. The top class also accelerate to complete the Years 8 – 10 coursework in two years, allowing eventual early completion of the Extension 1 HSC Mathematics in Year 11. In Year 12 students may continue to choose mathematics at the highest Extension 2 level in preparation for university or just for the love of the subject. Over the years, the record of achievement of the girls has been outstanding. They are often invited back to encourage younger girls, and attend the annual awards ceremony and presentation of certificates for excellence in mathematics.

Any enrichment program needs a strong mathematical base. The program culminates in the

Australian Intermediate Mathematics Olympiad (AIMO) for promising students up to Year 10. We also use the problems from the annual University of NSW School Mathematics Competitions. Our girls volunteer for entry to these competitions, and we use the experience for training purposes as part of the overall PLC Sydney Enrichment program. Other problems set by international competitions such as the World Team Mathematics Championship are also very useful.

The role of competitions in the enrichment program is very important. The Australian Mathematics Competition (AMC) is compulsory, while the more difficult ones are voluntary (only a selected group take part). These are useful training experiences for students as well as excellent sources of investigation and follow up. Part of Dr Lloyd’s role is to prepare students for these competitions without the pressure to gain high marks. The competitions enable growth through perseverance and higher mathematical thought.

We are unique in our approach to realising student potential and the promotion of mathematics as a career choice. In 2017, we were invited to attend the UNSW Girls Do Maths day and to University of Sydney for their Girls in Maths add up! day. It is a special interactive event designed to inspire and encourage young women to continue their studies in mathematics and statistics in their senior years at school, and hopefully beyond. Additionally, it is a great chance to find out more about the growing opportunities in science, technology, engineering and mathematics (STEM).

Our senior girls also attended UNSW for the Girls Do The Maths workshop where graduates and lecturers engaged them in interesting aspects of mathematics in the real world. As a staff, we are always looking for new initiatives to promote further study in mathematics.

Dr Dawe’s appointment five years ago has really added value to the mathematics program at PLC Sydney. In the process, the knowledge base of both the teachers and students continues to grow strongly through the enrichment program. ▲

MRS DIANNE BALKIZAS, HEAD OF FACULTY, MATHEMATICS



## INSPIRING INNOVATION AND CREATIVITY IONA PRESENTATION COLLEGE, WA

**D**riverless cars, smart phones, personal drones and smart housing systems — with all of these technologies created in recent times, we can only imagine the impressive skills and systems our children will be using in the future.

It is important that we prepare our children for the new and exciting jobs they will have and this means providing them with the skills they need for science, technology, engineering and mathematics (STEM) based careers.

A report by PwC (2015, April) states that 75 percent of the fastest growing occupations now require science, technology, engineering and mathematics skills; with more than 70 percent of Australian employers identifying STEM employees as being among the most innovative.

At Iona Presentation College, students are engaging in learning programs and activities aimed to increase their interest in STEM-related fields. They are being challenged with programs that develop their problem-solving and critical analysis capabilities while being encouraged to be curious, innovative and use their imaginations.

One such challenge, the Technovation Challenge, encouraged the students to create an app to address one of the United Nations Global Goals.

With some terrific brainstorming and prototyping, the girls devised a plan, coded their app using xcode and began the process of evaluating, testing, troubleshooting and recoding — before starting to develop a pitch for their creation.

Philippa, Shalia and Bridget describe their Technovation Challenge:

Our Technovation Challenge required us to identify a problem in the world, related to one of the United Nations’ Sustainable Development Goals. We then had to brainstorm an idea for an app which would contribute towards combatting the goal/s. Next, we created a business plan, outlining the different facets of our business and how we would market the app. Finally, we filmed a pitch and demo video to promote our app.

Our app is entitled ‘Foodlink’. It is a connection between businesses and charities with the aim to repurpose waste food. Businesses such as major supermarkets and bakeries can ‘offer’ items of food that they are unable to sell. Charities can then arrange, through the app, for delivery and usage of these items.

We chose this app because it addresses two United Nations Goals simultaneously; Goal 2 No Hunger and Goal 12 Reduction of Waste. It also



addresses the theme of Social Justice, which is Iona's core focus for 2017.

We believe this app can make a real difference to our community, and if we choose to promote it to businesses and develop it further, it could enable programs such as Iona's Community Cook-Up to use excess food to help the needy. When we were discussing possible ideas, this one appealed to us, as food wastage is a problem currently being discussed through many means, such as the War on Waste documentary, and this is a simple way to repurpose this food effectively.

We really enjoyed developing our skills with coding, not only learning how to use new programs and databases, but applying them in unique ways to create our app. Through the program, we also spent time with a mentor in NSW, Julianne Tancevski, who gave us amazing advice on how businesses operate and helped us to test our app. We also enjoyed using skills we had learnt through media classes at Iona to film a convincing pitch video.

The skills of creating an app are very important going into the future, as someone with knowledge of coding and apps will be well equipped to enter an industry such as technology. In the future, there will be many jobs related to computer programming as we move into the development of artificial intelligence and as our lives move online. Having experience with coding has given us a taste of this career pathway which we will consider in the future.

Women are certainly under-represented in the field of STEM, and we think it will be great to have more female role models in this area moving into the future. Seeing more women in these fields will inspire more girls to take up a career pathway in STEM, and this will inspire innovation and creativity from women as well as men.

Following this great challenge, we are all considering the option of studying engineering after we leave school, and it would be great to see more girls doing the same.

The Foodlink Pitch and demo videos can be viewed at [https://www.youtube.com/watch?v=hoNZCt1OX\\_0](https://www.youtube.com/watch?v=hoNZCt1OX_0) and <https://www.youtube.com/watch?v=qLW8izPFqIk> ▲

CATHY BROAD, TEAM LEADER, COMMUNITY RELATIONS

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## STEMIES: OUR PART OF THE SOLUTION ST AIDAN'S ANGLICAN GIRLS' SCHOOL, QUEENSLAND

**S**TEMIES is a school holiday program offering girls in Years 4 to 6 a day of workshops with St Aidan's Anglican Girls' School Old Girls who are studying in a STEM field. Since its inaugural event in April 2016, STEMIES has seen over 100 girls from St Aidan's and surrounding schools participate in workshops with activities as varied as blasting a biofilm, creating immune-cell cupcakes, building rockets and programming robots.

STEMIES is a response to the demand for more Australians to choose a career in STEM. "The importance of STEM disciplines for the future economic and social well-being of Australia cannot be underestimated. International research indicates that 75% of the fastest growing occupations require STEM skills and knowledge. Employment in STEM occupations is projected to grow at almost twice the pace of other occupations" (Australian Industry Group, 2013). In his 2013 report, the Chief Scientist called us to "utilise fully Australia's capacity in STEM to secure social, cultural and economic prosperity for all Australians while positioning Australia to advantage in a changing world" (Office of the Chief Scientist, 2013). STEMIES is designed to address the relatively low numbers of girls who pursue careers in STEM, particularly in the areas of engineering and computer sciences. Justman & Mendez (2016) explain:

Women's under-representation in high-paying jobs in engineering and information technology contributes substantially to the gender wage gap, reflecting similar patterns in higher education. We trace these patterns back to students' choice of advanced science, technology, engineering, and mathematics (STEM) subjects in the final years of secondary school. We find large male majorities in physics, information technology and specialist mathematics; and large female majorities in life sciences and health and human development. (p. 2)

STEMIES reaches girls in the primary years and aims to influence their aspirations and in turn, their subject choices in their secondary and tertiary education, in the hope that this will lead to more women in STEM careers in the future.



A review of research conducted by various organisations that promote women in STEM, identified an advisory body whose advice served as a useful framework for setting up the STEMIES program. The American Association of University Women (AAUW), a leading voice in promoting equity and education for women and girls in the United States, argued for the need for educational intervention in identity formation:

Our society tells girls and women that they don't belong in science, technology, engineering, and math (STEM) fields. As early as first grade, children have already developed a sense of gender identity, and most have developed unconscious bias associating boys with math. Toys still reinforce rigid, highly gendered stereotypes that encourage only boys to build or engineer. And even kids' clothing still proclaims that girls are bad at math. (American Association of University Women, 2017)

The AAUW's report *Why So Few? Women in Science, Technology, Engineering and Mathematics*, (2010) recommended cultivating girls' achievements, interest, and persistence in science and engineering through the following actions:

- Spread the word about girls' and women's achievements in math and science
- Expose girls to successful female role models in maths and science
- Teach students about stereotype threat
- Teach girls that intellectual skills, including math and science skills, grow over time
- Encourage and help girls to develop their spatial skills
- Help girls recognise their career-relevant skills
- Encourage high school girls to take calculus, physics, chemistry, computer science, and engineering classes when available.

Before launching the program, it was important to review the STEM offerings already available to girls in this age-group to ensure STEMIES met a need and was not in competition with existing programs. Firstly, the federal agenda to promote the implementation of Australian Curriculum Digital Technologies meant it was likely that girls would be developing skills in computational thinking in schools. A decision was made to use a maker-space approach to deliver areas such as coding and robotics so as to differentiate the program from approaches in schools. Secondly, it was noted that some STEM programs offered to girls outside of school hours were targeted at gifted students. A very deliberate choice was made to design a program that would challenge the negative stereotypes that hold girls back from these areas of study. The idea that only the best and brightest girls can be successful in STEM is part of the problem. A crucial message of STEMIES is that STEM is for every girl and every girl can find her own way to be a STEMIES girl.

At St Aidan's we are confident we have created something that meets our goal to influence girls' career aspirations through the development of STEMIES. It has been immensely satisfying to develop a program that in some way contributes to the national agenda for increased participation of women in STEM, in a way that has met the needs of our school community and is inclusive of our surrounding schools. ▲

KAREN MADDEN, DEAN OF INNOVATION AND ENGAGEMENT

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## CONNECTING WITH CODING KAMBALA, NSW

**W**hile most may become bewildered at the very thought of computer coding, or consider it a hobby reserved for the Steve Jobs and Mark Zuckerbergs of this world, Kambala junior school girls are proving that it is easily done. Coding lessons in the are met with enthusiasm and excitement as students work with their peers and teachers to understand the emerging and ever-expanding world of computer science.

This year, students in Years 3 to 6 have participated in coding lessons and are embracing the

integration of coding into key learning areas.

Learning to code, while a new and somewhat foreign language, has become an important aspect of the curriculum, and a valuable experience for our students of the digital age. Coding lessons are not what you may anticipate or envision; coding in the classroom does not simply refer to children glued to computer programs and apps, such as the much-loved Minecraft.

In fact, coding lessons in the junior school focus primarily around the concept of computational thinking, whereby students engage in problem decomposition, pattern recognition, solution abstraction and algorithm generation. Too complex for primary school-aged students? Not for Kambala girls! In the context of our junior school, this transfers as computer programming, a wonderful expression of computational thinking. Students in Years 3 and 4 put computational thinking into practice by instructing their iPads to carry out a task or command and then observe its success or failure. Year 3 and 4 students have particularly enjoyed using Tynker and Scratch Junior, and programming our resident mini robots 'Dash-and-Dot'. Such applications and activities have encouraged our students to create, collaborate, problem solve and think critically.



IMAGE: ANNALIESE LAKIS AND PHOEBE THEN (YEAR 6) LEARN HOW TO CREATE A WEBSITE

Our Year 6 students have been fortunate to learn from Kambala Old Girl and entrepreneur, Nikki Durkin (class of 2009). Nikki is currently working to develop software that teaches students about computer programming in a way that is both relevant and engaging. Nikki has joined our Year 6 classrooms to guide the students through website design, developing their understanding and competencies with HTML and CSS. Year 6 students have enjoyed the opportunity to work with someone who is clearly passionate and knowledgeable about this field. One eager student, Caitie Remen, Year 6, reports: "I really like coding class. It is very interesting being able to create a website, it will be very handy in the future!"

Our students clearly see the value in coding and the place it plays in their learning today. Lily Tucker,

Year 6, says "learning to code is important because it is the language of the future, or at least one of them!"

As we continue to find meaningful and engaging ways to integrate coding into our curriculum, we prepare our students for the world into which they are emerging. With focus on computational thinking and problem solving, we are giving them the opportunity to innovate and think, arguably the most valuable skills needed in our world today.

As you can see, computer coding has been an exciting and relevant addition to learning in the junior school. So if the junior school girls are beginning to learn code, what is stopping you? There is never a better time than now to learn how to code. ▲

SAMANTHA GOOCH, JUNIOR SCHOOL HEAD OF CURRICULUM

## INCREASING GIRLS' PARTICIPATION IN STEM

### STUARTHOLME SCHOOL, QUEENSLAND

Working in an all-girls, Catholic, independent boarding and day school and teaching within the information technology subject areas for fourteen years, I have always been interested in different teaching pedagogies and introducing new emerging technologies to develop interest within the subject area to increase student numbers.

A report commissioned by the National Broadband Network (NBN) and produced by the Regional Australia Institute, suggested a major shift in the role information technology (IT) plays in many jobs — with 50 percent of employees in 2030 to be in roles requiring high-level programming, coding and software design skills.

This report is supported by statistics from the Department of Employment predicting a strong technology growth of 12.8 percent by the end of 2018 (Department of Employment, 2017).

With the recent emerging technological focus, an assumption could be made that there would be an increase in students studying information technology subjects. Surprisingly digital technologies student numbers peaked at 25 percent of the Year 12 cohort in 2001, after which time it has been in steady decline (Kennedy, Quinn, Lyons, 2016). Research from this paper also highlighted a male bias.

Due to the decline in students studying STEM subjects especially female students, it is important to collect current data based around the student enrolments in the digital technologies subjects. By doing this we can seek recommendations to develop and implement effective policies and initiatives to rectify the downfall of student numbers, especially girls.

## How to encourage participation in STEM subjects

It is important for girls' schools to work together and share educators' knowledge, resources and unite for funding purposes. This year, a group of passionate and dedicated staff joined together from a range of independent schools to create the Brisbane Technologies Solutions Hub. The hub provides a platform to invite guest speakers from universities, businesses and the Queensland Curriculum and Assessment Authority who are experts in particular topics.

It is vital in girls' schools to provide authentic opportunities for the students to participate or attend STEM activities and events. Universities offer regular STEM days for free or minimal costs and from feedback from our students these have been successful in initiating interest. After school coding, robotics and science clubs are another way of encouraging participation in these areas. From my experience, girls learn and enjoy coding if they are having fun; able to express their opinions and freely ask questions without being judged. It is also important students enter the coding arena at a point suited to their level of expertise. This means classes could have students working at different levels which allows confidence to soar. Interest is soon lost if students do not understand the syntax or purpose of the code. Participation in online competitions such as the STEM video game competition; Bebras computational challenge are excellent for competitive students who enjoy a challenge.



Peer teaching, especially in the IT field, increases students' confidence and these students are not only an important resource for teachers within the classroom but mentors to other students.

## Benefits of studying STEM

There are so many benefits to be gained for the student if they study STEM subjects during their secondary education. It is important for parents and students to be aware of these benefits to realise the opportunities gained.

Some of the benefits of studying STEM subjects include:

- Students can find work anywhere before and after school. Some examples are: a Year 10 Digital Technology student designing game characters and environments as a paid job; and a 2016 Year 12 graduate who found a permanent part-time job updating a company's website while she studied an IT course at UQ. She also refined the website shop for the company so their production operated more efficiently.
- Choose from different career paths. STEM areas allows the student to take their career path into a number of different directions for example, engineering can be specialised into so many different fields including mining and civil.
- Students have the opportunity to work as part of a team or as an individual contributor.
- Opt for a career with growth potential.
- Opportunity to explore their creative side.
- Never stop learning or becoming bored. Technology changes at the speed of light so you never stop learning. ▲

LEIGH FERGUSON, LEADER OF LEARNING – TECHNOLOGIES

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## STEAM PATHWAY HARNESSES CREATIVITY AND CRITICAL THINKING

### WESTLAKE GIRLS HIGH SCHOOL, NEW ZEALAND

In 2017, teachers across all disciplines collaborated to design a pilot STEAM program for the Year 9 students that would integrate selected aspects of cross-curricular courses into a cohesive learning environment based on projects and real world experiences. The challenge teachers faced was to design courses to harness the students' creative mindset while maintaining core knowledge and understanding, in an interdisciplinary and applied approach. We limited the pilot to two classes in order to gauge the demand for this approach and measure success. Students were required to put in an application to be part of the classes and we were well oversubscribed with 112 applications for 55 positions.

Westlake Girls has always had successful Science and Mathematics departments with a very high uptake of the subjects in the senior years. We have also been actively involved in science-based extra-curricular activities such as VEX Robotics and NZYPT (New Zealand Young Physicists' Tournament). These extra-curricular activities develop skills that are lacking in the traditional classroom and provide a valuable foundation for related studies and careers. Robotics, for instance, brings together the creativity of robot design, the engineering skills of building the robot, the programming skills of making the robot move as required, the collaborative skills of working in a team, all within a fun and competitive environment. Past students have reported that these activities gave them a greater insight that helped them in post-secondary education. Dazzle Johnson commented, "Robotics helped me gain skills and gave me the confidence to study Mechatronics at university. I have a definite advantage because I feel that I know what I am doing and how to work in a team."

Feedback such as this cemented our increasing awareness that the creativity and innovation exhibited in successful extra-curricular activities could benefit a larger number of students if we could find a way to incorporate these elements into the classroom.

Our Year 9 STEAM program partially integrates the core subjects of Science, Mathematics, English and Social Studies in order to interlink real world problems and encourage cross-curricular thinking. The themes of global citizenship and sustainability are used to initiate critical thinking and help the students become solution-focused. Guest speakers and teacher experts add an extra dimension, with student projects involving a range of disciplines from recycling to building birdfeeders. Students use a Weebly site with shared responsibility to actively record their collective journey, publish interesting work and even design a short newspaper.

Within the options offered, we have a robotics half-year course where students use the VEX IQ platform in conjunction with Robot Virtual Worlds to learn to write programs using virtual robots to speed up their learning. This software can then be downloaded to a physical robot to help the students make the link between the emulated and physical world. Real life lessons such as the effect of friction become apparent when the real robot does not necessarily behave in exactly the same way as the virtual robot, requiring further problem solving.

A Papertronics and e-Textiles half-year course enables students to learn about series and parallel circuitry and use that information to build an interactive book and a small textile item using similar principles. A further half-year course takes students back to the principles needed at the start of the industrial revolution, by looking at energy generation. The main project used to teach these principles is the building of a small steam engine and other energy converting systems.

The World Economic Forum report of 2016 raised the point that 'Technological trends such as the Fourth Industrial Revolution will create many new cross-functional roles for which employees will need both technical and social and analytical skills. Most existing education systems at all levels provide highly siloed training and continue a number of 20th century practices that are hindering progress on today's talent and labor market.' This report reinforced the growing realisation amongst educators that the teaching approach has to be modified to meet the changing needs of students.

Our STEAM program addresses some of these concerns by helping students to make links between subject areas, and to use their creativity to address issues and envisage solutions in a cross-curricular way. It is important to create a field of dreams, establish opportunities for students to experience using subject content in a variety of creative ways, and hence instill a motivation for learning, rather than just learning in subject-isolated arenas.



IMAGE: STEAM STUDENTS TESTING THEIR ROBOT SKILLS

After half a year, the program has been very successful with students saying that it shows them "good links to the way future jobs will be organised" and they feel "able to explore different ways to solve problems." They enjoy "the creative style of learning" and the "team building activities where they get to know the strengths and weaknesses of team members." They believe it is "an amazing opportunity to do these things at school." Motivated students who have learned the art of lateral thinking and problem solving will make the best kind of citizens in tomorrow's knowledge economy.

With the backing of a proven team of teachers now dedicated and committed to this exciting new STEAM pathway, we look forward to extending the program into Year 10 in 2018. ▲

MERRYL HAMLING, DEPUTY PRINCIPAL IN CHARGE OF STEAM

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## CHANNELLING CAREER CHOICES TOWARDS STEM

### ST MICHAEL'S COLLEGIATE SCHOOL, TASMANIA

STEM education is a hot topic in Australian schools. Recent research by Microsoft demonstrates that girls are most engaged in STEM subjects at age 11, with interest rapidly declining at age 15.

"Conformity to social expectations, gender stereotypes, gender roles and lack of role models continue to channel girls' career choices away from STEM fields", said psychology professor Martin Bauer of the London School of Economics, who helped coordinate the survey of 11,500 girls across 12 European countries (Petroff, 2017).

Collegiate's principal, Judith Tudball believes providing inspiration, relatable examples and role models for girls in STEM fields is crucial. "Many girls admit they'd feel more confident pursuing a STEM career if they knew men and women were already equally employed in these fields, so it's more important than ever to help both girls and their parents understand that they can be successful in this area and appreciate the range of pathways available."



IMAGE: COLLEGIATE'S CUSTOM FIRE PIT AROUND WHICH GUESTS ENJOY A MULLED WINE BEFORE THE EVENT

Collegiate adopts a truly integrated approach in the classroom, which sees the girls develop a transferable set of 21st century skills. STEM skills are developed from junior school age at Collegiate with girls learning to both code and experiment with robotics technology. Options as they progress through the school are extensive and include ICT club, digital media, photography, 3D printing and SWIFT coding. Students are also able to create and explore with virtual reality HTC goggles opening up a new world of creativity.

A relatively new event on the school calendar is the Principal's Midwinter Symposium which encourages Hobartians to brave the chilly June evenings in the search of inspiration. The symposium is one way to directly share the brilliant knowledge and experience that exists within the Collegiate network with our parents and the wider community.

Under the topic *Collegiate Women in Science*, a panel of four of the school's old girls was convened for the 2017 event. With an impressive alumni that spans 125 years, the school has no shortage of accomplished women to draw upon. This year's line-up featured Dr Anthea Rhodes (Class of 1996), paediatrician at The Royal Children's Hospital, Melbourne and Director of the Australian Child Health Poll; Penny Griffiths (Class of 1995), Manager of Strategy at Ixom; Tammy Chu (Class of 1994), Managing Director of Entura and Dr Joanna Jones (Class of 1995), Lecturer in Horticulture, Viticulture and Farm Business Management at the University of Tasmania.

The women were selected for their extraordinary achievements across different fields of science, technology, engineering and mathematics (STEM). Mrs Tudball explained "It's not enough to tell a young girl that she can do anything, it's far more powerful if you can *show* her she can do anything. For that reason, we are committed to highlighting inspirational role-models, many of whom are Collegiate women, so that our girls can build strong connections with them. These women have acquired knowledge in the same classrooms as our current students, so the girls really relate to them. The same inspiration is also true for adults. When you take the time to hear someone's story first hand, it really makes you appreciate their journey. Seeing Collegiate women in leadership roles and listening to them highlight the choices available to the girls of today really helps empower our parents. It provides knowledge to help them guide their daughters through some of the most significant decisions they will undertake as young adults."

Symposium panellist Tammy Chu explained, "It's about confidence, self-belief and knowing choices exist." It's an opinion supported by Professor Michelle Simmons, one of Australia's most celebrated computing scientists, who recently commented that "The best thing you can do is the subjects you find most challenging. As you go through your career, opportunities will open up." (Ross, 2016).

With the demand for STEM skills growing rapidly in the workplace, Collegiate is committed to continual investment in its teaching and learning facilities. A planned upgrade of STEM learning spaces was explained by panellist Dr Anthea Rhodes "As well as being fantastic places to learn in, great facilities tend to draw inspiring people to a workplace." The other crucial part of the equation is dedicated teaching staff and mentors. Collegiate is proud of its passionate staff who go the extra mile, including science and mathematics teacher Glenn Carmichael who was recently recognised as a 2017 Apple

Distinguished Educator — one of only 22 teachers across the country.

The discussion surrounding the importance of STEM skills at the 2017 Symposium quickly raised consistent themes of critical thinking, persistence, self-belief, passion and leadership. In the closing words of the symposium, chemical engineer Ms Penny Griffiths noted, “The majority of jobs moving forward will be underpinned by the capabilities of STEM related theory and practice. STEM will not lock you into a research career, there are myriad opportunities to balance analytical ability, process thinking and problem solving with just about anything. These skills will set you apart and open doors that you won’t believe.” ▲

AMANDA MACKINNON, HEAD OF MARKETING AND COMMUNICATIONS

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## CREATING INNOVATORS CAMBERWELL GIRLS GRAMMAR SCHOOL, VICTORIA

**T**inkering with paddle pop sticks, straws and toothpicks may not seem an obvious route to solving the world’s problems. However, making something from nothing through play, design and construction is becoming recognised internationally as a critical pathway to developing innovative thinking and problem solving.

Camberwell Girls Grammar School recently opened its new MakerSpace as part of a commitment to providing students with the best learning opportunities to ensure they become motivated and creative innovators.

The MakerSpace and a connected robotics lab are part of the refurbishment of science spaces in the centre of the school. This multifunction design and construction space incorporates a science lab, art room, workshop and computer lab. The MakerSpace also features expansive windows and glazed doors designed to encourage passing students to be inspired by the activities within.

Different height workbenches and an exciting array of tools and equipment including a laser cutter,

a drop drill, sewing machines and 3D printers line the walls with a diverse range of everyday materials in accessible storage.

Coordinated by a team of art, science and commerce teachers, the MakerSpace is not subject-centric and is available to students and staff at lunchtimes and after school three days a week as well as during class time.

Already history students have designed and produced artefacts including longwords and catapults, English students have made puppets to recreate scenes from *To Kill A Mockingbird* and fashion students have designed textiles, later printed through a partnership with fabric designer Frankie & Swiss. A race track is currently under construction to help students learn about gear ratios and sustainable energy.

In late June the MakerSpace was put to use as part of the Days for Girls International program. Students, staff and volunteers from Days for Girls spent the day sewing products to go into feminine hygiene packs for girls and women around the world who don’t have access to such products.

Other student projects range from designing an iPhone cable protector sleeve and sustainable housing to an upcoming project which aims to transform the delivery of emergency services in Australia.

Principal Debbie Dunwoody says learning by doing and creating solutions to real problems is an important part of education at Camberwell Girls.

“We’re living in a world that values ideas and girls particularly need to gain the confidence to back themselves and their ideas. You gain this confidence through trial and error and embracing your challenges, failures and successes. We’re encouraging learning through doing in every part of the school,” Ms Dunwoody says.

Head of art Mark Barnett says the MakerSpace helps break down gender stereotyping.

“Many girls may have only seen a saw in their garage; here they learn to use whatever tools they need to produce their projects.

“Practical skills are very important. For example, girls who go on to study engineering at Swinburne University will join all female race teams where they need to know how to weld, how to design and build gears... we have to prepare our girls to take the next step in whatever they want to pursue,” Mr Barnett says.

Wide sliding glass doors connect the MakerSpace to the school’s new robotics lab where the program includes Dash robots, Bee-bots, Sphero robots, Lego NXT, EV3 robotics and humanoid NAO robots from France.

Head of science Eleanor Wood says that software is language of the world and it’s becoming a critical layer of all our lives.



“We don’t just want our girls to use technology, we want them to be creators of it,” says Ms Wood. ▲

BELINDA KRANJIC, MARKETING AND COMMUNICATIONS MANAGER

## STEAM@ABBOTSLEIGH ABBOTSLEIGH, NSW

**W**ith a strong history of girls’ engagement in mathematics and the sciences, Abbotsleigh has responded to the need to provide further opportunities for engagement in science, technology, engineering, the arts and mathematics (STEAM) education.

At Abbotsleigh, this includes both curricular and co-curricular pursuits. In equipping our students for the future workforce, we continue to move them towards learning that is transdisciplinary in nature and develops the skills in collaboration and design thinking that will be necessary for them to succeed in the globally connected world of work they will enter. The integration of the arts is integral to this along with the development of computational thinking skills. Both are essential learning, as the tools they will use will require media literacies beyond that of text.

Before beginning our STEAM journey it was important that we considered what we wanted to achieve and how this fitted within our context. At Abbotsleigh, we have a strong focus on service

learning and encourage our students to engage with a range of issues both global and local. With this in mind, the integration of the arts into STEM education fitted with our approach. This provides a focus on real world applications of theoretical content.

The initial integration of STEAM focused on the co-curricular program. A fledgling robotics club started by an enthusiastic member of the Science team quickly grew. Within 12 months the team of dedicated students supported by mentors from Macquarie University were competing in the FIRST Robotics World Championships in the USA. At the same time, Abbotsleigh offered Middle School students the opportunity to attend Junior Space School in Houston Texas over the Christmas break. Thirty-two students engaged in the ten-day immersive experience that provided insight into the world of space exploration.

The genuine engagement with real world learning these students demonstrated provided the impetus for the development of programs within the curriculum. Our aim was to develop a STEAM program that recognised the importance of these disciplines to girls’ knowledge and skills. We committed to the training and support of staff to develop curriculum that is interdisciplinary in nature and promotes engagement with STEAM. The aim has always been to find authentic opportunities for learning that can be embedded within the current curriculum, harnessing the natural connections that exist between each of the STEAM disciplines.

The initial projects focused on mapping common areas of content across the Years 7 and 8 science and mathematics curriculums. These were

developed into programs that encouraged students to find real world applications. When developing each project the following questions became our guiding principles. Does the project harness areas of student interest and passion? Is it relevant to the world they live in? Does it encourage them to explore the multiple shades of grey in a very complex world? In responding to these questions, a project-based learning approach has provided the most effective pedagogy. Finding opportunities for our students to engage with ambiguity has also been a significant learning for staff.

IMAGE: YEAR 7 STUDENTS PRESENTING THEIR WATER STORAGE AND FILTRATION DEVICE



Abbotsleigh was a pilot school for one of the STEM units developed by the NSW Education Standards Authority (NESA) in 2016. Year 7 students used their knowledge and skills in science, technology and mathematics to solve a design thinking challenge involving water use. We took the main ideas from the sample and adapted it to our context. Students completed learning activities in science and mathematics to investigate a series of driving questions about water availability and use in Australia, the importance of water to life and the accessibility and storage of clean water for all. Using a design thinking approach students engineered a prototype of a water storage device to collect and store water for a family home in a particular location. Students needed to understand the region they were building the prototype for to ensure the features were suited to the environment. The project culminated with students planning, testing, building, and presenting their prototypes to their peers.

This is only the beginning of our STEAM journey. As we move through each iteration of our program, we move closer to the goal of transdisciplinary learning. However, the impact is already evident. In the past two years, we have seen increased numbers of girls participating in computing subjects across all years. We have more students exploring future career options in all fields of engineering, mechatronics and robotics. Participation in our co-curricular STEAM programs continues to grow with students as young

as Years 1 and 2 engaging with coding. We believe this is an important step in preparing our students for their future as world citizens. ▲

LINDA EMMS, HEAD OF CURRICULUM AND KATHRYN FRASER, HEAD OF SCIENCE

## PER ARDUA AD ALTA; THROUGH STRIVING TO THE HEIGHTS METHODIST LADIES' COLLEGE, WA

At Methodist Ladies' College (MLC) in Claremont, students are prepared for entering an ever-changing workforce where technology and innovation are integral in addressing Australia's future needs. Central to this is STEM (Science, Technology, Engineering and Mathematics) as recognised by several organisations including consulting firm PricewaterhouseCoopers who state that "research indicates that 75 per cent of the fastest growing occupations now require STEM skills" (2015, p14). Accordingly, students at MLC are exposed to a variety of STEM programs and experiences to improve their ability to develop essential knowledge and skills for post-school destinations.

MLC has developed learning opportunities for its students across five main areas: curriculum, co-curriculum, special events, university and industry engagement, and community interaction.

### Curriculum

Digital literacy, creative thinking and problem solving skills are taught within the science, mathematics and technologies courses from early in a student's learning journey. The learners' passion for these courses continues through into Years 9 and 10 when they are able to choose subjects beyond the compulsory courses including Engineering Studies, Environmental Studies and Technologies (Digital, Applied Information, Food, Materials and Design). MLC students are also in the highly advantageous position in Years 11 and 12 of being able to select from the largest range of STEM courses made possible by creative timetabling and a partnership with our neighbouring school, Christ Church Grammar School.

### Co-curriculum

Developing critical thinking, enterprise and team-work skills are enabled through participation in our co-curricular program. Students at MLC have opportunities to compete at state, national and international levels through involvement in the Science Olympiads, the Australian Brain Bee Challenge, ICAS (International Competitions and Assessments

in Schools), Australian National Chemistry Quiz and the RACI Titration Competition. In addition to extending their content knowledge, students develop initiative, resilience and persistence. Furthermore, as many of the competitions are team-based, students' collaborative, interpersonal and problem solving skills are enhanced. Additional co-curricular programs on offer at MLC include CoderDojo and Science Club for junior years' students where they have the opportunity to conduct practicals and determine hypotheses to test experimentally.



### Special Events

While National Science Week provides the perfect setting to immerse our students in activities such as the Faraday Challenge to pique their interest in STEM courses and develop their analytical thinking skills, students regularly hear from visiting guest speakers. Over recent years, students have conversed with a payload engineer from NASA, researchers from the CSIRO, Professor Lyn Beazley Chief Scientist of WA (past) and a short-listed candidate for the Mars One project. There is a wealth of knowledge amongst collegians and the wider MLC community, and they are so willing to share their experiences and expertise with the students.

### University and Industry Engagement

Knowing the opportunities available to students following their formal schooling is essential to facilitating the transition to further study or work. Therefore, engaging with universities and industry through incursions, excursions and mentoring, is instrumental in helping the students to view real world applications of their studies. Some of the initiatives include participating in the Girls in Engineering program at the University of Western Australia, mentoring by oil and gas industry representatives through the Petroleum Club of Western Australia and travelling to NASA as part of the HASSE Space School Junior and Senior School Programs.

### Community Interaction

Involving the community is fundamental in developing skills to prepare students for an ever changing workforce. The MLC Masterclass program conducted over the school holidays takes STEM

beyond MLC. This initiative allows primary school-aged children to participate in engaging courses such as science, coding and robotics. Conducted by MLC teachers or community members and assisted by our students, these sessions teach STEM content and skills, stimulate an interest in related subjects and enhance creativity. Furthermore, as our student assistants lead the younger students they develop their organisational, communication and collaborative working skills.

To determine how well MLC prepares our students for post-school destinations, we continually measure the outcomes of the initiatives at MLC. This involves examining enrolment data for STEM courses, formally surveying current students and parents, and analysing graduate destination data to determine the number of students transitioning to STEM careers or courses at tertiary institutions. At MLC, over the past three years there has been an increase in the number of students studying STEM courses in Years 11 and 12, and 42 percent of our graduates from 2016 entered further study or careers in STEM.

It is recognised that the future workplace will be vastly different from the one we have now, so if we are to prepare our students to be adaptable and thrive in this environment they need to be taught essential knowledge and skills, primarily STEM skills. MLC is a progressive, grounded and inclusive organisation and its diversity of programs on offer to our students prepares them for the future workplace. ▲

DR LAINIE GARA, HEAD OF SCIENCE

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## EQUIPPING GIRLS FOR REALITY IN THE 21ST CENTURY ST CATHERINE'S SCHOOL, VICTORIA

When a Second World War poster in a classroom can 'come alive' by discussing the war with onlookers, or Pompeii can be explored street by street without leaving the classroom, it is likely students are going to be highly engaged with their learning.

With the use of virtual reality (VR) and augmented reality (AR) technology, St Catherine's students have been exploring the streets of Pompeii without leaving their classroom and enjoying History lessons transformed with interactive Second World War posters.

Students at St Catherine's are extended beyond the textbook through state-of-the-art technology to learn complex and unforgettable lessons firsthand.

The activities provide 'hands-on and minds-on' lessons for students, as well as ensuring the learning is highly engaging and enjoyable.

This term, the school introduced a new elective for Years 9 and 10 students, The Augmented and Virtual World. This is the first of its kind in Australia. It not only teaches students to understand and use AR and VR but to create platforms in both media. As well as learning about how the technology works, virtual and augmented reality offers opportunities for students to learn with a hands-on approach.

Samuel Johnson once wrote that: "The use of travelling is to regulate imagination by reality, and instead of thinking how things may be, to see them as they are." While this has great relevance in many aspects of our lives, from an educational viewpoint the importance of providing firsthand experience using excursions and field trips has long been understood.



Using VR to virtually transport students to locations on the other side of the world provides an array of experiential learning possibilities. The class can visit ancient monuments and many of the world's inspiring museums and natural environments. With a 360-degree viewing platform, students can virtually walk through the streets of a European city, hike the trails of the Rocky Mountains or visit a Moroccan souk.

Our Years 7 and 8 students are enjoying virtual field trips to the pyramids in Egypt, Mount Vesuvius and Pompeii via VR headsets. The technology is so advanced it enables students to explore street by street without physically leaving the classroom. The possibilities for virtual travel worldwide are endless, as are opportunities to explore within the human body. Henry Miller said that: "One's destination is never a place, but a new way of seeing things." With this philosophy in mind, our virtual excursions are certainly a new way to travel.

Augmented reality provides an abundance of teaching opportunities. Teachers can adapt digital information to real world objects and link information to online resources. Using AR, our Year 10 History program incorporates videos embedded within the students' work, such as an image, a poster or object. This involves scanning an image using a smart phone to unveil a myriad of information, videos and websites to complement the information.

The importance of school programs to be current with new technologies and innovations is required to match technologies used in our rapidly changing world. For teachers, developing new curriculum material is both exciting and at the cutting edge of technology.

In preparing students for the 21st century world, such programming skills will prepare students for a future workforce where online literacy, combined with creative and entrepreneurial thinking will be necessary.

There is currently a shortage of IT professionals in Australia with this sector recognised within the employment market to continue growing. With this in mind, St Catherine's is striving to be at forefront of such innovative streams of learning. Learning that leading educationalists say will hold the key to success in our rapidly changing world.

In fact, we are equipping our students with the skills necessary to flourish in careers and industries not even imagined. ▲

ALEX BORLENGHI, ST CATHERINE'S SCHOOL, HEAD OF DIGITAL LEARNING AND TIDE

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## PRAISE DEPENDENT OR POWERFUL QUT, QUEENSLAND

Over-praising and under-performing are often twin-bedfellows — indeed, the latter is all too often an unintentional outcome of the former. Joel Meares, a Generation Y Australian, reflected somewhat ruefully in the Sydney Morning Herald on his experience of being on the receiving end of excessive attention and praise in his early life:

We were raised on a diet of constant reinforcement and told we could do anything. Keen to boost our self-esteem, Mum and Dad sacrificed their weekends to chauffeur us from soccer to ballet to drama to Nippers ... Our teachers showered us with unjustifiable praise ... In kindergarten I won an award for tying my shoelaces a week later than everyone else; in year 7, I won a ribbon for not finishing a cross-country run (Meares, 2011, p. 13).

Meares went on to note how inadequately this prepared him, and his peers, for the complex and at times cut-throat adult world in which he now finds himself. Little wonder, says academic Michael

Foley, that individuals like Meares find themselves under-equipped to handle the difficult situations that arise as the 'rules' for employability start shifting and a degree is no longer a passport to professional work on a liveable wage. Foley sees the current generation's belief that they are entitled to accolades for easy success as an effect, at least in part, of our society's willingness to elevate 'self-esteem' as a social good worthy for its own sake, while having no values or principle and requiring no effort beyond its insistence on positive self-reflection from others. *Difficulty*, on the other hand, he sees as a contrary imperative that has been overwhelmed by the effects of raising self-esteem:

Difficulty has become repugnant because it denies entitlement, disenchanting potential, limits mobility and flexibility, delays gratification, distracts from distraction and demands responsibility, commitment, attention and thought (Foley, 2010).

Foley is not alone in commenting negatively on the consequences of elevating self-esteem over actual performance. At a now-famous graduation ceremony at Wellesley High School in the United States, the keynote speaker — English teacher David McCullough, Jr — departed from the traditional congratulatory rhetoric, telling the assembled graduates that they were neither special nor exceptional, but probably believed they were because they had been "pampered, cosseted, doted upon, helmeted, and bubble-wrapped, feted and fawned over". An effect, he argued, of Americans' "love of accolades more than genuine achievement". This shot across the bows of praise-dependency underlines what Erika Christakis — an early childhood educator at the Yale Child Study Center — described in *Time* magazine as "the cheapening effect of making everything special" (Christakis, 2012). Being 'special' becomes a right, not an achievement. To be treated in any other way, regardless of your behaviour or performance, becomes unthinkable.

#### Too much consolation, not enough challenge?

Recent research appears to suggest, at least in part, that the praise-dependency identified overtly at Wellesley High is not only widespread but could be an unintended outcome of the work of 'consoling' teachers. In an article published in the *Journal of Experimental Social Psychology* entitled "It's ok — Not everyone can be good at math", Aneeta Rattan, Catherine Good and Carol Dweck provide evidence from a sample of first year university students that fleshes out the downside of praise-dependency in young people. Importantly, it suggests that well-meaning teachers may be aiding and abetting student vulnerability rather than student capability:

[The research] suggests that an educational system focused on accepting weaknesses (as long as one focuses on strengths) is not quite as positive as intended. It may lead to situations in which the forces pushing students to dis-engage from important fields of study are stronger than

those encouraging them to persevere through difficulty. Thus, the popular practice today of identifying weaknesses and turning students toward their strengths may be another self-esteem-building strategy gone awry... and one that may contribute to the low numbers of students pursuing math and science (Rattan, Good, & Dweck, 2012, p. 6).

There is no doubt that a praised and consoled generation of young people are much more likely to emerge from schools feeling a whole lot better about themselves than the kids who emerged from classrooms in which sarcasm, shaming and negative criticism of children were normal practice. The problem, however, is that today's young people will have to meet criteria for twenty-first century employability that are all about what they give to the team and the organisation, not what they get in the way of attention and accolades. Praise-dependent young people looking for easy, well-remunerated employment will search in vain in the marketplace. Put simply, those who look to enter paid work with a sense of entitlement, but with no little or no supporting evidence of proven capacity for higher order thinking and doing, will flounder in our highly competitive labour market.

Employers are already expressing more than a little exasperation with what is being perceived as a pampered generation that is unrealistic when it comes to the demands of well-remunerated work. In a comment in the Weekend Business section of the *Sydney Morning Herald*, Marcus Padley launched a scathing attack on Australia's young adults as "Gen Useless", urging them to "stop sponging and start scrubbing up for work" (Padley, 2012, p. 7). While it is unfair to throw a blanket over an entire generation as too indulged to be work-ready, there are certainly concerns that a shrinking global labour market and a strong sense of personal entitlement among today's youth, when taken together, do not augur well for their future employability. Put bluntly, employers are much more interested in hiring someone who is a proven collaborator and self-starter than someone who is expecting the comfort of on-going affirmation as well as their own air-conditioned office and leather chair.

#### What now, my love?

So how might teachers and parents assist much-loved children to be better prepared for an independent and creative future? As creative economist John Howkins points out, contemporary patterns of work don't spring from one single imperative or individual. They arise instead from a mix of individuals' inclinations, relevant processes and products, and the social arrangements in the place where they are located. In his book, *The Creative Economy: How people make money from ideas* (2001), he goes on to say that the most employable people in creative workplaces are those who embrace the challenges of being part of a dynamic team, both separate and together with others. He says:

When two or more creative people are working in a team, and could not succeed without the team, even to the extent of 'losing' their identity in the team, it is still their personal talent and individual contribution that generates the creativity and the product. It holds both ways. If someone who is part of a team is only part of a team, then they are giving nothing of themselves and they cannot be creative (Howkins, 2001, p. 7).

Creative workers, in short, are most often part of a dynamic process that involves *both* individual smarts and a capacity to work *within* and for a high-flying and dynamic team with social networks that reach well beyond their own. The take-home message is that creative and innovative workplaces seek out individuals who are personally highly capable and who also welcome and value the opportunity to contribute to dynamic, highly-achieving teams. ▲

**PROFESSOR ERICA MCWILLIAM**  
**ADJUNCT PROFESSOR, FACULTY OF EDUCATION**

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## A HEADSTART FOR SUCCESS PLC MELBOURNE, VICTORIA

**P**LC Melbourne students are consciously prepared for the dynamic future world of work through many engaging and imaginative academic and personal development programs.

The PLC Gifted Education and Extension Program partners with several leading universities and a national art gallery to implement an academically accelerated research mentoring program for gifted adolescents (14 – 17 years).

These programs offer engaging high-level challenges under expert guidance and provide the opportunity for gifted students to follow their academic and creative passions with like-minded peers.

Over the years, students have participated in unique mentoring programs in areas such as astrophysics, engineering, phototonics, physical sciences, ecology and the environment and behavioural and health sciences.

In the humanities field, students have participated in expert mentoring in fields including law, classics, computational linguistics, music composition, history and psychology, writing and publishing, portrait painting, printmaking, Socratic dialogue and play writing and have represented Australia in two International Computational Linguistics Olympiads. Students also worked with the head curators at the NGV on an extended mentoring opportunity to help design the "Dali-Liquid Desire" Winter Masterpieces Exhibition.



**IMAGE: YEAR 10 STUDENTS PARTICIPATING IN CUTTING-EDGE EXPERIMENTS IN THE DEAKIN UNIVERSITY LABORATORY**

In one outstanding annual STEM program, twelve Year 10 girls have the very special opportunity to work in the cutting-edge cellular and molecular biology laboratory at Deakin University and to participate in an exciting one week program. For over ten years, the laboratory manager has designed a carefully tailored and stimulating program which involves intensive laboratory work and lectures at undergraduate standard.

This Work Experience and Mentoring program is facilitated through the PLC Extension and Careers Departments, meaning that the girls also have the opportunity to hear about possible tertiary pathways and careers in STEM areas first hand, from post-doctoral students, in a specific careers session. PLC students will soon have the chance to participate in another high-level research and internship project with senior academics from the Engineering Department of a leading Victorian university, who are engaged in ground-breaking research and development.

The program targets girls of high intellectual ability and motivation who want to be stretched intellectually and to develop the key transferable soft skills which will help them in their future STEAM studies and careers. They experience new intellectual horizons by being willing to try new subjects and grow personally through encouragement to be intellectually and creatively curious.

These activities are allied with the college's activity-reflection Student Portfolio. From Year 10 onwards, students map their journey, by keeping individual portfolios which are a collection of their academic and personal achievements, with a strong emphasis on transferable skills. The portfolio becomes a key resource for students to draw on when applying for high-level tertiary courses, for overseas universities which require personal statements, and for work placements.

By following an inquiry learning model in Years 7–10 and then by exploring aspects of university life while still at school, students gain a head-start for entry to top Australian, US and UK universities while developing the self-regulation, mindset and skills required for life-long talent pathways in a rapidly changing world. Students' personal testimony, significant personal growth and outstanding academic school and post-school success can often be specifically linked to the opportunities and outcomes provided by these programs.

In addition to providing responsive and highly-challenging learning environments to enable students to develop the skills to deal with the disruptive technologies, huge advances and swift changes of the future world of work, it is essential to provide effective role models. The Careers Development Section of the College organizes an annual program of career talks where Old Collegians and others speak to girls in Years 10, 11 and 12 about the challenges of work and the need for a flexible and open approach to career planning.

Girls hear about the many different tertiary courses that lead to particular careers and the need to remain resilient and optimistic when it is necessary to diverge from previous career goals due to changing life and career circumstances. It is important that the chosen speakers are easy for the students to relate to and are honest about the ups and downs of working life. This helps the students to understand that there that there are often many pathways to their dream careers or entrepreneurial goals. Many notable international and local speakers provide PLC staff with professional development to help them prepare students for the exciting world of work in the information era where the capacity of individuals for lifetime learning is paramount. ▲

**SUSAN KNOPFELMACHER, HEAD OF GIFTED EDUCATION AND EXTENSION PROGRAMS AND JULIE SCHROEDER, COMMUNITY RELATIONS**

## WHAT DOES IT MEAN TO BE EDUCATED? SANTA MARIA COLLEGE, WA

**I**n Australia we see education as a right. It is at the core of order in our society. It's a political football. It's big business. And choosing an education is often a parenting nightmare. As with most aspects of parenting, there is a growing obsession with getting it 'right'. Yet there is very little discussion at any level of what it means to be 'educated'.

Santa Maria College Principal, Ian Elder, has been teaching for over 40 years. He has been principal of two of WA's most innovative and successful schools and with mere months until his retirement, he maintains a level of enthusiasm for education that is inspiring. He is the perfect person to ask, what does it mean to be educated?

In short his answer is, "The aim of education is to improve the human condition. We need to learn to know, learn to do and learn to live together." It is a poetic answer, but it speaks to a recognition that change is upon us. Mr Elder says that in the past education has been about preparation for jobs. Those jobs could be identified, named and we could set our sights on a specific objective. That has changed.

Mr Elder uses as his example the law profession. When we employ a lawyer, essentially what we are purchasing is their experience and knowledge. They have the ability to recall precedent and calculate the probability that a case will go to trial. That process can and will be automated and the highly esteemed profession will change dramatically. So why are we educating people for this and other jobs that are going to disappear? He cites *The Economist* (June 2016) which states that 47 percent of Americans are in jobs that will soon be automated.

Our education model was largely formed by the Industrial Age. It was designed to educate as many people as possible, as quickly as possible. It was then refined by the Technology Age. Now, as almost a logical progression, we have entered the Age of Innovation.

Mr Elder recognises that the idea of innovation frightens many, however he believes we are all capable of that sort of creativity. He points out that Santa Maria College runs programs for 10 and 11 year olds that focus on innovation. These kids are not defined by the traditional mindset that you are either an arts person or a science person. He is keen to break down the traditional dichotomy that results in gender stereotypes about future subject selections. A brain is a brain; it doesn't favour one kind of knowledge, and it was built to explore, question and create.

So what is essential in an education? Mr Elder believes that these are the top skills that are required

by a school leaver: problem solving, critical thinking, creativity, people management, collaboration with others, emotional intelligence and decision making with a moral prerogative. The last skill he explains with, "If a child leaves school and they don't understand and value difference, if they are not compassionate and they do not have a sense of social justice or value community service, then we have failed."

Mr Elder believes it is not just schools that need to change, but universities too. In fact, universities first, as they are what drives the measurement culture of all education. If a university is demanding a particular entrance mark, schools will conform and teach the content required to attain that mark. Because teachers care about the opportunities available to kids, they help students jump through the hoops that enable opportunity. The hoops need review.



Education is at the crossroads. "The age of elite advantage is over." By this he means, if all information is now available online then the traditional ways of completing upper secondary and university courses is available to all without the need to attend a particular educational institution. Having said that, while online education can assist with 'learn to know' and 'learn to do', the 'learning to live together' and his listed skills of the future require face to face interaction.

Mr Elder sees the library of the future as a library of people. The library remains a centre piece of educational institutions but returns full circle to the mentorship of Ancient Greece. We may not be walking around courtyards in robes and sandals, but teaching will be conversation. We will learn to think creatively and apply knowledge and ultimately...innovate.

In Singapore, the shift from knowledge to skills is already obvious. As part of their SkillsFuture initiative, the government currently offers a \$500 credit to every citizen over 25 who wants to upgrade their skill set. That shows an investment in skills not seen before. Those skills are often in the area of high tech manufacturing. What are the skills that Australia would subsidise if such a scheme existed?

Singapore also aims to create a virtual Silicone Valley. Imagine a highly connected network of universities and companies from around the world.

This system would provide budding entrepreneurs with the global networks to develop, finance and commercialise innovations. It's a brave new world.

So, in the midst of all this change, with a job market that is unpredictable, what advice does Mr Elder give school leavers? "You need to be technologically competent, but ultimately, follow your passion." And he is right. Passion is the constant. Skills can be learnt and the future will present new types of jobs and career opportunities, so passion is the compass that needs to guide us. ▲

LINDA STADE, RESEARCH OFFICER

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## PHYSICS WITHOUT BORDERS SANTA MARIA COLLEGE, VICTORIA

Always exploring ways in which to promote the study of physics at Santa Maria College; a new Year 10 elective was piloted in 2016. To respond to change, to think critically, to solve problems creatively and innovatively within the parameters confined by our workplaces are just some of the STEM skills we hoped to instil in our students, thereby preparing them for the future of work.



Physics without Borders was introduced in an attempt to increase the number of young women at the college choosing Physics as a subject in VCE. It was also introduced to provoke an appreciation of the relevance of the physical sciences outside a science classroom and to show the impact physics has in our technological world.

From the outset, this was a subject that was different. Firstly, the classes explored physics outside the confines or borders of the classroom. Partnerships with scientists, physicists, engineers and other physical science practitioners were established. These partnerships enabled students to explore the role of physics by visiting workplaces, listen to presentations and being involved in programs offered through these partnerships. The program and partnerships established have allowed the students to reflect in depth about the relevance of physics, how it is applied, the positive and negative implications and how it might impact upon their futures.

The Physics Without Borders class visited Air Traffic Control at Tullamarine Airport, the Police AirWing at Essendon Airport, the Lasertag workshop offered by the Outreach program at Latrobe University and the Australian International Airshow at Avalon Airport, to name a few. The students have also been fortunate to listen to presentations by scientists from various fields including an automotive engineer from Ford, an air traffic controller, a particles and fields physicist and many more. One of the scientists is even hoping to join the Mars One program!

Secondly, students have worked both collaboratively and independently making models of cars, solar powered cars and rockets. This inquiry based, hands on learning approach has allowed the students to investigate and apply physics principles to meet the brief of the model design and in each case, possibly further improve the model using their new-found knowledge of applying creative applications to their problem solving skills.

Thirdly, this subject has provided transparency to the transference and bridging of skills from other subject areas. Students have discovered that in order to be successful and proficient at physics, they need to draw on their skills learned in mathematics, in particular, units and unit conversions, rates and rate conversions, scientific notation, significant figures, degrees of accuracy, graph interpretation and the application and transformation of formulae with and without technology.

There have been other considerations which have enabled this elective subject to be successful at Santa Maria College. Physics without Borders is allocated two, 75 minute lessons each week. One week, these are the last lessons on two different days enabling the class to leave the college at lunchtime to visit workplaces or attend presentations. This has minimised the impact of students missing any other classes. On the other week, the two lessons are timetabled on two different days to be the first period allowing visiting presenters to come to the college early and return to work with less impact on their work day.

Some of the Physics without Borders students reflected on their experience of this new elective:

The Year 10 Physics elective was one of my favourite subjects and has completely shown me the opportunities and possibilities that Physics

can bring... and the endless amount of jobs it can lead to definitely swayed me to choose the subject in VCE and hopefully continue to study this in the future.

The excursions have provided great insight into the real-world applications of content covered within the classroom. My participation in this elective also gave me the confidence to pursue Physics into VCE. It has broadened my perceptions of what Physics involves and demonstrated the many branches of specific study that will be available. Physics challenges my thinking in a way that is logic-based and genuinely interesting. It is a subject that excites curiosity.

The Year 10 Physics course had a great balance between written work and hands on work. I loved meeting and listening to real experts and how they apply physics in their everyday jobs.

The subject opened up opportunities for me through seeking out a work experience placement in the field of physics. This also helped me realise that I want to incorporate Physics in my future career pathways. If it wasn't for the Year 10 Physics elective, I would not be doing Physics now in Year 11 and in my future schooling and career.

After completing Year 10 Physics, I now look at things in my life with a new perspective. The course gave me a practical and fun way to dive into the world of physics and allowed me to see the pathway of my future study more clearly.

Physics without Borders has changed the perception of students about physics as a subject. It has not only ignited a curiosity in what could be possible but it has allowed students a glimpse into their future — how different realms of thinking in a physical and technological sense will be part of their not too distant homes and workplaces. ▲

JACINTA DEYLEN, NUMERACY LEADER AND YEAR 10 PHYSICS TEACHER

## LEARNING TO USE THE TOOLS OF TOMORROW IVANHOE GIRLS' GRAMMAR SCHOOL, VICTORIA

When people talk about "technology", they think of the Internet, smartphones and computers. But technology has been around for centuries; it is, essentially, the tools that we use to get things done. Today's technology is so flexible and sophisticated it allows us to communicate through social media, learn new information, entertain ourselves and even 3D print parts of a house.

The tools we need today will not be the same as the tools we will use tomorrow. The aim of digital learning at Ivanhoe Girls' Grammar School is to prepare students to be ready for the tools and technology of the future.

Ivanhoe Girls' has introduced a new elective subject in 2017 for Year 9 students focused on app development and coding". Students will learn the programming and coding skills they need to successfully create their own web application for touchscreen devices. The girls decide what they want to create, which could be anything from their own platform game to an app to keep track of the time spent on homework for each subject.

During the course, students will learn the programming principles behind writing code and use Microsoft Touch Develop, an object-oriented framework based on JavaScript, to build and modify their apps. These programming principles can later be applied to many other computer languages, giving students a strong foundation for further studies or a career in engineering or computer science. Students will also gain an insight into the industry and hear from those who have forged a career in app development.

However, the benefits of learning to code include a lot more than just technical skills. Programming requires problem solving and logic, which are invaluable skills in any profession. Students must think critically and strategically as they create accurate code. They also learn that proper design is an iterative process; their solutions will fail many times before they arrive at the desired one.



Our students have responded very well to digital learning; it can feel like a game where they are solving puzzles, while at the same time they are able to express their creativity. The new subject has been met with strong enthusiasm, with over 20 percent of Year 9 enrolling in the first year.

Coding has also been embraced at Ivanhoe Girls' in the junior school, with the establishment of a lunchtime Coding Club for girls in Prep to Year 6.

Girls are introduced to Code Studio, a platform for learning basic coding and computer science. They learn to write the detailed steps of code required to draw simple diagrams, complete pictures and move gaming characters around mazes.

We are also establishing a Coding Club for Year 7 to Year 12 this semester. We hope to provide a supportive environment to allow students to explore programming tools and software. They can use computers to solve complex problems, create web apps, build 3D games or program electronics to control the physical world. This club will complement and build on the existing 3D Wednesdays, where students have access to 3D printing technology to create and program objects from their imagination.

We aim to encourage students to see their computers, tablets and smartphones as tools with which they can create and achieve anything. ▲

ALEX LEAHY, HEAD OF DIGITAL LEARNING

## STEM WITH A DIFFERENCE ST MARGARET'S ANGLICAN GIRLS SCHOOL, QUEENSLAND

It is widely advocated that STEM education is the future of our economy. No matter what the industry, the future of employment will be in jobs that require skills in science, technology, engineering and mathematics.

Despite government and private reports and press articles advocating for the integration of STEM within subjects, academic literature does not seem to provide a clear direction for effectively integrating STEM disciplines (English, 2016). St Margaret's Anglican Girls School offers a STEM experience with a difference by timetabling an elective class in Years 9 and 10, where students are immersed in a transdisciplinary approach to science, technology, engineering and mathematics. Chris Farrelly, Manager – STEM Enrichment Programs, believes that *engagement* is key to enabling student learning, and engagement flows from a project-based learning approach, where the context is current, real, and relevant to young women. Engagement is further enhanced where the challenge offered by the project is significant, or at least non-trivial.

In a similar fashion to STEM in many schools, a rich context is used as the central focus. However, as a dedicated stand-alone subject, there is a single teacher facilitating a class focusing on STEM, rather than subject-silos like Science, Maths, or Technology working to a STEM theme. STEM should be seen as more than just a collection of subjects, but should emphasise the core disciplines appropriately. It was suggested by English (2016) that most STEM programs in schools become, by default, Science extension classes.

At St Margaret's, the STEM elective class is freed from the constraint of curriculum achievement standards for any particular year level or subject. Instead, a learning pathway is dictated by the project challenge and its context. When mathematical skills are needed, they are taught, drawing from which ever year level is required. Scaffolding is provided to support students with any unfamiliar concepts they may not yet have covered in their traditional maths subjects. Similarly, where projects draw on a foundation in science, the use and application of technologies or engineering methodology, this content is also taught; all within the one classroom and by the same teacher. The range of content knowledge and skill needs to be assessed based upon the project challenge, and how students developed those skills to meet the project goals. The STEM project becomes the key theme that links all lessons together in a coherent learning experience.

Projects undertaken by STEM classes have included: the building of remotely controlled model aircraft; the design and fabrication of a prosthetic hand; and the design and fabrication of a prototype wing for an autonomous glider. These projects are interdisciplinary and incorporate a range of technologies (remote controllers for the aeroplanes, microprocessors and servo's for the hand, and microprocessors, accelerometers and gyroscopes for the autonomous gliders). Mr Farrelly said that, very importantly, these projects were all beyond what the class of female students thought they would be able to do. "The pride shown by students in their achievements in STEM class was marked; there was a real sense of empowerment for the girls, and an appreciation of possible STEM pathways in their futures," he said.



## Drone Academy

The St Margaret's Drone Academy has been established to create a unified STEM theme extending from upper primary through the secondary years. The Drone Academy will provide a unique opportunity for girls to be immersed in the engineering and science implicit in flying drones, such as using drones for collecting geospatial data, photography and videography, and all manner of airborne scientific surveying. The Drone Academy engages girls with STEM in a meaningful and fun way; it promotes a connection between school and home given that many students' families now have and use drones, particularly boarder families in rural Queensland, but also families who are increasingly using drones recreationally. Linking authentic connections with the real world, providing girls-only opportunities to explore drones and family involvement are some of the key areas identified for implementing effective STEM programs aimed at girls (Chapman & Vivian, 2017), and the Drone Academy is focused on targeting these areas.

St Margaret's seeks to empower girls to experiment and lead the way with this new technology – a technology that is even more male dominated than is usual in the STEM fields. It is estimated that less than one per cent of licenced drone pilots are female (Joyce 2016). Students will see these devices as the valuable tools they are, rather than an annoying interloper at the beach or park.

Different programs will be offered at different developmental stages, ranging from practical flying skills and text-based coding for Year 6, coding and design through to Year 9, and the opportunity to complete a pilot's license course in Year 10.

## Robotics Club

The St Margaret's Robotics Club provides an extra-curricular opportunity for students to engage in a STEM driven environment encouraging students' exploration of science and technology.

The Years 5 to 7 students firstly learn how to program their robots, dragging and dropping different coloured programming blocks onto a timeline to create a series of movements, actions or sounds. Each week a challenge is set for the robot to perform a series of movements; for example, go forward, go left, turn around and so on.

St Margaret's Head of Science Trish Kirkpatrick explained: "The girls practice not only STEM knowledge but problem solving, innovation, collaboration and the ability to become critical and creative thinkers, building life-long skills transferrable to any field." ▲

CHRIS FARRELLY, MANAGER – STEM ENRICHMENT PROGRAMS

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## AHEAD OF THE GAME MENTONE GIRLS' GRAMMAR SCHOOL, VICTORIA

**R**obotics, engineering, forensic analysis and computer coding are not considered to be typical activities for young girls, but at Mentone Girls' Grammar School, it's the norm as the school continues to break the gender mould with innovative and contemporary STEM (Science, Technology, Engineering and Mathematics) programs.

There is no denying that STEM related jobs are key to economic growth and have the strongest career prospects at the moment, yet the number of female students choosing to pursue STEM related careers is on the decline.

Through an enterprise-based curriculum, Mentone Girls' Grammar is aiming to combat this problem by helping students arm themselves with a resume of skills and knowledge that will put them ahead of the game.

Head of Science, Helen Silvester, and Head of Digital Technologies, Michelle Dennis, have seen a massive influx of students choosing to study STEM in VCE or at tertiary-level.

"Learning STEM related subjects is much more than memorising a series of concepts and equations. It involves curiosity, the ability to relate concepts to the real world, to work effectively in groups, to learn about project management, as well as the collection and analysis of data," Mrs Silvester said.

"In Year 9, for example, students use their knowledge of ecosystems and plant function to design and build model vertical gardens that increases the productivity of a set plot of land, which they present in a 'shark tank' style presentation that validates the cost of building such a project. It is science and enterprise working together.

"We want our students to find their foothold and thrive in their future worlds, and this requires an education that not only adds academic value, but

also develops 21st century skills that will allow them to adapt to the challenges that lie ahead."

In March this year, six senior students competed at the Asia-PAC FIRST Robotics Competition, and were part of the winning group 'Melbourne Robocats', sponsored by Swinburne University's Innovation Precinct, beating 38 other robotic teams across Australia. The all-girls team spent six weeks building a full-sized robot that required them to collect energy balls and shoot them into a hopper; collect and insert gears onto a lever that could be pulled up; and raise itself off the ground.

Michelle Dennis, a self-proclaimed technology geek, also believes that learning STEM, even at a basic level is a necessary skill for young girls. Students are introduced to computer programming in the Junior School, which is then followed up by compulsory digital technologies lessons in Years 7 – 9.



"We believe that a grasp of coding principles enables students to comprehend more complex computer operations, and starts to demystify the online world. This is in the same way as the understanding of basic vocabulary and grammatical structures provides a beginner with access to a foreign language," said Ms Dennis.

"Coding at school opens a door to a host of IT-related roles, and we are confident that no matter the field, students will look on the knowledge they learned at school for use in their future careers."

In Year 9, students learn to use *Unity* – the same software used by professional game developers that created Pokémon Go, Assassin's Creed and Temple Run. Similar to the Enterprise Academy initiative in their Science classes, students develop a video game idea, pitch it to the class and then collectively vote for the ones they want to build as a virtual reality game.

Ms Dennis is excited that Mentone Girls' Grammar School is introducing VCE Computing in 2018, which will allow girls in Year 10 to take up where they left off in Digital Technologies and further develop their IT skills.

"There are hardly any girls' schools that offer VCE Computing as an optional subject, as opposed to

boys' or co-ed schools. With this new offering, we will be one of the very few girls' schools in Australia that successfully taps into IT," said Ms Dennis.

"I truly believe the skills our students are currently learning will be an excellent toolkit for them in the future. We will always maintain an eye on the future as we continue to positively influence our students and create a culture of engagement and excellence across these STEM fields, ensuring they feel empowered to pursue their interests." ▲

SOPHIE TUDOR, COMMUNICATIONS COORDINATOR



## PLANNING FOR THE UNKNOWN SACRÉ CŒUR, VICTORIA

**L**ike many schools, Sacré Cœur understands the world of work is changing and we need to prepare our students for the future of 'unknown unknowns' as well as 'known unknowns'. How do we do this?

Our students study robotics at both primary and secondary levels for a number of years as part of their core curriculum. As well, many students elect to take part in Robocup (an international competition that fosters artificial intelligence (AI) and robotics research). We have offered a digital technologies subject at both Years 9 and 10 as an elective and for a medium-sized school we have healthy numbers in Physics and Specialist Mathematics. Our Physics students had hands on campus experience through the building of our underground car park and opportunities at Qantas in the flight simulator but these students are the 'converted'. How can we ensure all our students are "women who shape their world"? How can we ensure they all have exposure and encouragement and a passion for what we know are the skills required to "thrive in a transforming world" (Hannon, 2017)?

As always, we began with 'why', when as part of our strategic plan, we examined the concept of contemporary learning. Our research led us to conclude that contemporary learning at Sacré Cœur needed to be based around four key principles, these being: connection, agency, mastery and authenticity.

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These four principles encapsulate the mindsets and habits required for a successful transition into the world beyond the school walls — to be able to negotiate with confidence the ‘unknown unknowns’. From this research grew our STEAM project.

Our STEAM project aims to offer an interdisciplinary program at Year 10, taught by a team of experts in their area across science, technology, arts (including the humanities), engineering and mathematics. These teachers, masters in their subjects, will set students onto the path of mastery by supporting them with expert guidance. Students will also be involved in collaboration through this program with a number of other students, teachers and our wider community and will come to understand the importance of these different areas being intertwined and complementary when coming up with solutions to complex problems or the process of production of a tangible end product.



Another one of the aims of the program will be to influencing students’ thinking in terms of connecting what they learn with the reality of what the world needs from its women (and men) in terms of skills needed for jobs of the future. This is a major shift for schools, particularly girls’ schools, but our students deserve this change. The world they will step into is one where science, technology, engineering and mathematics are held in high importance. The humanities provide a context and art, in the words of John Keats “gives food for the soul”, transcends the merely utilitarian, and is the essential ingredient that provides the aesthetic flavor — it is what makes life worth living!

This is an exciting time to be an educator in girls’ schools with our young women poised to take up the challenges of our world for their future and the future of further generations. ▲

JENNIFER CARTER, DIRECTOR OF LEARNING AND TEACHING

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## MY SUPERSTARS OF STEM Crooked SCIENCE

**S**uperstars of STEM is an excellent initiative by Science & Technology Australia “working with 30 of the nation’s most dynamic scientists and technologists to create role models for young women and girls, and work towards equal representation in the media of men and women in STEM” (Science & Technology Australia, 2017). Given the greater public visibility of men in STEM (science, technology, engineering and mathematics), particularly in the media, such strategies as the Superstars of STEM are very important.

While education is predominantly a female field, STEM education is still dominated by men (Weldon, 2015). However, if I was to choose my own superstars of STEM based on my own experiences, particularly in STEM education, they would almost all be women. We don’t have to look far for superstars of STEM, they are all around us.

Earlier this year I completed my PhD in physics education research at The University of Sydney (Crook, 2017a). My supervisor through this wonderful learning journey was Professor Manju Sharma. Manju is the Head of Sydney University Physics Education Research (SUPER) group; Leader of Advancing Science and Engineering through Laboratory Learning (ASELL Schools); Leader of Science and Mathematics Network of Australian university educators (SaMnet) and Principal Fellow at UK Higher Education Academy.

Manju is a world-leader in evidence-based STEM education research. She is regularly a keynote speaker at international conferences, responsible for millions of dollars in STEM education initiatives, has published over 200 articles and is an active advocate for girls in STEM. At a personal level, she guided me through thick and thin during my PhD and has co-authored many of the publications stemming from my research.

My co-supervisor was Dr Rachel Wilson. Rachel is Senior Lecturer in Research Methodology, Educational Assessment & Evaluation in the Faculty of Education & Social Work at The University of Sydney. Many of you will have heard Rachel give interviews and have read her work as she is the go to person for the ABC and SMH regarding the demise of STEM in Australia, particularly the fall in uptake of high level mathematics by girls (McNeilage, 2013; Palmer, 2013; Wilson, 2015a, 2015b). Rachel has particularly strong opinions on such matters and ensures that society at large is aware of such problems. As the leading expert at USyd on quantitative analysis in education research, Rachel was an amazing help to me and co-authored much of my research. We also co-wrote a piece for *The Conversation* on the challenges of teaching science in primary school (Crook & Wilson, 2015).

Dr Helen Georgiou is a lecturer in science education at the University of Wollongong. Helen is an up-and-coming STEM education academic. Completing her PhD in the same research group a few years ahead of me, she has been a massive influence. Recently, we co-presented a colloquium at the USyd School of Physics on the forthcoming changes to the NSW HSC Physics Syllabus and are in the midst of writing an article on the subject for the Australian Institute of Physics. Helen is particularly active online and on social media and is not afraid to engage people in evidence-based discussion. However, much to our alarm and disgust, Helen was subjected to some incredibly patronising and insulting remarks, solely because of her gender, among the comments to my recent *Conversation* article on the new physics syllabus (Crook, 2017b). This was a real eye-opener for me, having never been subjected to such mansplaining or offensiveness.

Dr Jane Hunter is a Senior Lecturer in the school of Education at the University of Technology Sydney conducting postdoctoral research in STEM. Jane is incredibly experienced as a leading STEM academic, teacher, school leader, policy maker and in large-scale technology innovation programs. Jane is a champion of such STEM initiatives as *High Possibility Classrooms* (Hunter, 2015) and *STEAMPunks*, the latter an excellent event organised by Debbie Evans, Principal of Bondi Beach Public School (Evans, 2016; Hunter, 2016). I have been fortunate to share the odd panel at STEM conferences with Jane. Jane and I are currently in the midst of collaborating on an article around issues with STEM in Australia.

**NOW I THINK ABOUT IT, ALL OF THE STEM EXPERTS WITH WHOM I HAVE CO-AUTHORED HAVE BEEN WOMEN, WITH THE EXCEPTION OF DEREK MULLER OF VERITASIAM FAME (MULLER, 2017). THEIR GENDER NEVER OCCURRED TO ME — THEY ARE THE EXPERTS.**

On a more regular basis than academic writing, I interact with STEM experts daily in my work in schools, online, particularly through social media, and semi-regularly at events such as TeachMeets (TeachMeet Sydney, 2017). Yet again, the key exponents and superstars in my personal experience are all women.

Margaret Shepherd and Maree Woods are the current and previous presidents respectively of the Science Teachers’ Association of NSW (STANSW). Margaret and Maree are two of the hardest working people I know. They both essentially do two jobs with their day jobs (Margaret is a Science Leader of Learning at Sydney Catholic Schools and Maree is Science Coordinator at Aquinas College, Menai) and their STANSW responsibilities. Margaret and Maree work tirelessly to ensure that NSW science teachers have access to the best professional development opportunities with widely lauded events such as *Meet the Markers* and amazing opportunities for students with events such as the *Young Scientist*

*Awards* (Science Teachers’ Association of NSW, 2017). I am fortunate enough to work with both women in both their STANSW capacities and professional work.

Alice Leung, Stage 6 Advisor with the NSW Department of Education, is an award-winning STEM educator (Leung, 2017a) with an absolutely prolific social media presence and an incredibly selfless philosophy, helping as many STEM educators with ideas and support as she can. Among Alice’s long list of achievements and the diversity of her work, she set up the *Awesome NSW Science Teachers* Facebook group (Leung, 2017b). This has proved to be a massive success by teachers and educators from across the state helping and supporting each other, particularly those who are new to STEM. In a similar vein, Kelly Hollis, Assistant Science Coordinator at Rosebank College, is another award-winning STEM educator with an equally prolific online and social media presence (Hollis, 2017). Kelly is co-founder of *#aussieED*, the biggest conversation on Twitter regarding education in Australia (aussieED, 2017). Kelly is particularly innovative in utilising digital technologies in science education.

Bron Stuckey is one of the world’s leading experts in game-based learning, gamification online learning communities (Stuckey, 2017). Bron is regularly found delivering keynotes, presenting workshops and sitting on panels at STEM conferences. She is particularly active and vocal about promoting opportunities for and championing girls in STEM. Kelly Bauer, Innovation and STEM Coordinator at Parramatta Marist is another award-winning STEM educator with particular expertise in multimedia and technology. I worked with Kelly years ago and she has always been my go to expert for all things technology and multimedia. Again, she is another selfless colleague sharing her expertise far and wide, particularly through the *ICT Educators of NSW* (ICT Educators NSW, 2017). Sue Faroukh from OLMC Parramatta is yet another award-winning STEM educator, with a well-respected profile in physics and science in particular. Sue has a very strong online and social media presence. Sue is incredibly generous with her time, sharing her ideas at TeachMeets and as a Tutor of Communication and Digital Technologies at ACU (Faroukh, 2017).

By definition, this list is personal and by no means definitive. I consider myself very fortunate to work with these women in one capacity or another. If this was LinkedIn, they would all be my *Influencers*. While society at large worships the cult of male celebrity STEM experts such as Brian Cox, Neil deGrasse Tyson and Dr Karl, we would do well to look closer to home at the phenomenal talent around us which would be a more balanced gender mix, or, as in my experience, mostly female. ▲

DR SIMON CROOK

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## DATES FOR YOUR DIARY

### 2017 EVENTS

- ▶ **19 OCTOBER / SOUTH AUSTRALIA**  
Twilight Networking Event  
St Peter's Girls' School
- ▶ **24 OCTOBER / NEW SOUTH WALES**  
Networking Event  
**Guest speaker: Susan Moylan-Coombs**  
The Women's College, Sydney University
- ▶ **7 NOVEMBER / WESTERN AUSTRALIA**  
Christmas Networking Event  
Santa Maria College
- ▶ **9 NOVEMBER / VICTORIA**  
Twilight Networking Event  
Our Lady of the Sacred Heart, Bentleigh
- ▶ **23 NOVEMBER / TASMANIA**  
Tasmanian Alliance Executive meeting  
Board and Senior Staff Christmas function  
Mt Carmel College
- ▶ **11 DECEMBER / QUEENSLAND**  
Christmas Lunch  
The Brisbane Club

### 2018 EVENTS

- ▶ **3–6 JANUARY / QUEENSLAND**  
Student Leadership Conference  
Bond University
- ▶ **5–7 MAY / SOUTH AUSTRALIA**  
Fearless Girls. Strong Women.  
Adelaide Convention Centre

All information is correct at time of printing.

Please visit [www.agsa.org.au/events](http://www.agsa.org.au/events) for updates and information.

## HONORARY MEMBERSHIP AWARD



**K**aren Spiller OAM, Principal of St Aidan's Anglican Girls' School in Brisbane has been awarded honorary membership of the Alliance of Girls' Schools Australasia, the highest honour the Alliance bestows. The award recognises outstanding women and men who have made a significant contribution to the Alliance and to girls' education and who have shown general advocacy for women's rights and equality.

Ms Spiller's nomination stated in part "Karen demonstrates sustained and significant contribution through her professional leadership as an educator. She has done this at her own school and has contributed to independent schools throughout Australia. Karen's leadership has had state and nation wide impact in many areas but especially in developing women leaders and in encouraging STEM for girls. Karen has continually demonstrated outstanding leadership qualities throughout her lengthy career in a variety of professional and voluntary contexts."

Karen has teaching and leadership experience in both girls' and co-educational Anglican schools for over 30 years and has been Principal at St Aidan's since 2000.

She is Chair of the National Board of the Association of Heads of Independent Schools Australia. She is also Vice-President of the Board of Independent Schools, Queensland and is a past National President of the Alliance of Girls' Schools Australasia (2009–2011).

In 2010 Karen was a finalist at the AIM Management Excellence Awards in the category of Not-for-Profit Manager of the Year (Brisbane).

Also in 2010 Karen was recognised by the Australian Government as a recipient of the National Award for Excellence in School Music Education 2010: Excellence by a School Leader.

In 2010 and 2011 Karen was a finalist in the EOWA Employer of Choice for Women Business Achievement Awards in the category of Leading CEO for the Advancement of Women.

In 2011 Karen was awarded a Churchill Fellowship "to examine strategies for preparing female leaders for the position of Principalship in Australian Schools" and travelled to the United Kingdom and the United States for this study.

In 2013 Karen was awarded Fellow of "The CEO Institute" and appointed a Fellow of Bond University and Principal in Residence.

In 2017 Karen was awarded the Medal of the Order of Australia (OAM) recognising 'her service to women and to education'.

Karen is a Fellow of the Australian Institute of Management, the Australian Institute of Company Directors, the Australian Human Resources Institute, the Australian Council for Educational Leaders and the Australian College of Educators. ▲



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# ALLIANCE OF GIRLS' SCHOOLS AUSTRALASIA

The Alliance of Girls' Schools Australasia is a not for profit organisation which advocates for and supports the distinctive work of girls' schools in their provision of unparalleled opportunities for girls.

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