

Enlightening Stem Engagement During High School – Make It Real Banana Peel

Scott-Parker, B.

Adolescent Risk Research Unit (ARRU), Sunshine Coast Mind and Neuroscience – Thompson Institute

School of Social Sciences, University of the Sunshine Coast

Barone-Nugent, E.

School of Physics, University of Melbourne

Abstract

Global progress has arisen from scientific advances and we currently live in the age of science, technology, engineering and mathematics (STEM); science as a way of increasing the knowledge base, technology as a means of manifesting the science, engineering as a way of building and creating with it, and mathematics to devise the language we use for science to explore new realities. Strengthening science-related economies requires more students to pursue STEM subjects which means that we need to retain them early in the education pipeline in order to strengthen knowledge-based communities and nations' economic growth. In Australia, however, there is a trend of more occupations requiring STEM skills while there is a declining interest in studying STEM subjects at secondary school. The disengagement of students from STEM subjects is most notable amongst girls towards the physical sciences such as physics and mathematics. When girls are considering life pathways at high school they generally view STEM subjects as difficult, leading to career pathways that are not aligned to their interests. With the exception of biology girls do not deem STEM subjects as relevant to improving the human condition. Moreover, the STEM subjects are not viewed as interconnected and contributing to areas of knowledge that impact our lives. To increase the accessibility of STEM subjects and STEM careers to enable students and unblock the pipeline into the work sector we need to rationalise how the STEM areas work together and impacts the fabric of life beyond the knowledge silos. In addition, as educators we need to show young people how STEM skills and learnings are integrated into areas such as psychology, economics, computing, and data science. In this paper we describe how a pilot of the *Growing Tall Poppies STEM* program (GTP) has enabled female high school students and (largely) female scientists at the University of the Sunshine Coast to explore the interdigitated nature of STEM subjects and psychology to support the understanding of how STEM skills are important, relevant, and life changing. By way of background, the GTP program framework was developed to encourage secondary students, particularly girls, to

choose to study STEM subjects in their final years of secondary school by demonstrating (a) the relevance of these subjects to their everyday lives, (b) that girls are capable of STEM-related academic success, (c) that STEM subjects are career-empowering, by (d) providing examples that debunk the stereotypic expectations of female students and employees. This pilot project highlighted how the STEM skills of critical thinking, problem solving, and innovation can be used *beyond* traditional STEM disciplines such as psychology. In this regard, a group of four Year 10 girls were immersed in an applied social psychology laboratory in 2016 to participate in a genuine research investigation, and students were given autonomy to contribute and take charge of their own project question. Thus the girls experienced firsthand the interdisciplinary nature of STEM disciplines, and in this way STEM learnings were related to a broader range of applications and career paths for these students. While this pilot was the first university-high school GTP collaboration, pleasingly this group of students advised that they felt inspired to continue in their study of STEM subjects on their return to school, and indicated that they were more inclined to choose STEM subjects beyond Year 10.

How to change student perception of STEM at school – make it real banana peel

Women an untapped resource for STEM

The global economy is increasingly relying on science, technology, engineering and mathematics (STEM) education as a vehicle to supporting the need for innovation in these key domains. Research indicates that 75% of the fastest increasing occupations require skills in STEM (Becker & Park, 2011). In Australia it is estimated that over one million STEM graduates will be needed in the next ten years to meet this demand (Shin, Levy, & London, 2016). Yet as occupations requiring STEM skills are trending upwards there is a global downward trend of students, especially girls, studying STEM subjects in school beyond the compulsory years, and this trend is strongly reflected in university enrolments and in the larger workforce. In

light of what is happening at secondary school it remains difficult to address STEM skill shortages in the workforce with an ever-decreasing pool with which to work (Office of the Chief Scientist, 2013). Additionally, it seems that Australia is not placing the same urgency on this STEM-shortage as perhaps other countries may be (Marginson, Tytler, Freeman, & Roberts, 2013). The Australian Industry Group (AIG) highlights that the current decline in STEM skills is restraining economic growth, maintaining that to meet the challenges of a rapidly changing economy, we need to grow our skill base, particularly in STEM disciplines (AIG, 2013). Further analysis by the AIG (AIG, 2015) strongly indicates that Australia under-performs in global comparisons of STEM-engagement, urgently calling for a national STEM skills strategy that begins in the schooling sector with a more engaging school curriculum that motivates students to be STEM-skilled. Regardless of population growth, Australia continues a decline in STEM education beyond the compulsory years of high school with the current gender disparity indeed the greatest seen for three decades (Kennedy, Lyons & Quinn, 2014).

Thus we advocate that the curriculum must create pedagogical vehicles to ensure more students study STEM subjects, including the clearly-untapped resource of women. Such revision would help ameliorate the STEM skill shortage more generally, and contribute to the 'hoary chestnut' of gender equity in STEM disciplines specifically. The *'Progressing STEM skills'* (AIG, 2015) report notably calls for measures to encourage girls to remain enrolled in STEM subjects at school. Girls do not pursue STEM subjects or careers for complex reasons both historical and circumstantial, including preparation deficits in senior school (Froschl & Sprung, 2014), insufficient parental support (Lyon, 2014), lack of role models (Herrmann et al., 2016) and stereotypes regarding male domination of the field, the difficulty and/or (ir)relevance of the subjects, and girls' sense of lacking capacity in these subjects (Shin et al., 2016; Koch & Irby, 2014; Barone-Nugent et al., 2012). Curriculum alone cannot address all the complexities of these limiting factors, however it can address certain aspects. To illustrate, areas that can be addressed are breaking down male stereotypes, improving self-efficacy,

linking STEM skills to relevant or human based outcomes, and demonstrating how well paid and respected careers (rather than vocations) are directly linked to having STEM skills. Using these four principles embedded in practical curriculum and pedagogy, the *Growing Tall Poppies STEM* (GTP) program has demonstrated that it is possible to increase the number of enrolments of Year 12 girls in Physics, and these principles can be used more widely for STEM subjects (Barone-Nugent et al., 2012; GTP, 2018). Since 2008 GTP has focussed on increasing the number of girls studying Physics beyond Year 10, helping to unblock the pipeline to a STEM subject that opens choices for girls that would otherwise remain elusive and unachievable (Barone-Nugent, Quiney & Nugent, 2012).

It is time to make a difference by employing practical measures, such as demonstrated in the GTP STEM program, together with Australia's four national initiatives to support girls and women for STEM skills growth – (1) Science in Australia Gender Equity Pilot, (2) Male Champions of Change in STEMM (Science, Technology, Engineering, Mathematics and Medicine), (3) Women in STEMM Australia and (4) Women in STEM and Entrepreneurship. Alone, the four initiatives make STEM(M) discipline and education pathways a viable option, but such isolation does not directly include efforts aimed at increasing the pool from which we can source STEM-related talent. Rather, school-based intervention programs such as the GTP STEM program will be the 'game changer' for our nation to increase the number of girls with STEM skills, and to increase the number of girls who subsequently choose to work within STEM discipline areas. In this way, an integrated STEM education system – rather than a disjointed, reactive system specifically targeting disciplines such as primary and secondary efforts in engineering, geosciences, and technology with diverse methods of inquiry and 'pipeline preparation' for STEM tertiary studies and careers (Caldwell et al., 2018) – challenges the notion that the conventional approach to teaching STEM subjects is the most constructive way to address the STEM skills shortage at the educational level, with a diversity of student-centred learning most commonly reported by STEM educators (Lucietto et al., 2018)

Indeed, conventional curriculum and pedagogies has resulted in reduced student STEM student enrolments in Years 11 and 12 in Australia simply because students have lost interest, highlighting the critical importance of authenticity and applicability as motivators in learning (Sanders, 2009). Students, and particularly girls, need to be introduced to subjects in a manner which encourages them to stay enrolled in STEM subjects at high school, which consequently increases the likelihood of these students pursuing STEM-related employment beyond high school (De Philippis, 2016; Lyon, 2014; Starks & Matthae-

us, 2018). Interest can also be scaffolded through partnership programs such as GTP, with female secondary students afforded the opportunity to immerse themselves in an out-of-classroom learning environment as secondary schools connect with universities, science facilities, and corporations (GTP, 2019), with enriched informal learning environments key to improving scientific reasoning ability (eg., Gerber, Cavallo, and Marek, 2001). Moreover, the GTP program appears to be the ideal 'first contact' personal interaction mechanism that it is argued is fundamental to recruit and/or retain STEM recruits generally, and female STEM recruits specifically (e.g., see Starks & Matthaeus, 2018).

Growing Tall Poppies Stem Programs Are Authentic

The Growing Tall Poppies STEM program (GTP) is an authentic science¹ learning program primarily aimed at Years 10 and 11 with the goal of increasing the number of students, particularly girls, who study sciences in Years 11 and 12 (Barone-Nugent et al., 2012). The program was founded in 2008 by teacher and scientist, Dr Eroia Barone-Nugent, to address the declining number of girls taking science subjects beyond the compulsory years. The program began in Victoria, Australia, and has since been rolled out to Queensland and New South Wales with current Federal Government funding through the Australian Maths and Science Partnership Program. The focus of the GTP intervention program takes the seemingly esoteric STEM areas and identifies why they are relevant to our lives, that they are achievable, that the often STEM-associated stereotypes are wrong, and that these subjects lead to interesting, valued and well-paid career pathways. Where students can imagine STEM subjects as boring and irrelevant, the GTP program changes their perception 'first hand'. The program is based on partnerships between scientists and STEM-facilitated areas in universities, scientists, and students and teachers in schools. Students are immersed in an authentic learning environment working on current research issues alongside (a) scientist(s) for three to five days, leading the investigation while being guided by the scientist(s). Therefore, this partnership in the workplace means that students work on real science questions that problem-solve using an integrated approach which delves into how the skills derived from STEM subjects can change outcomes for individuals, communities and societies.

The GTP program is curriculum based and relates the pedagogical framework to science outcomes in the Australian Curriculum, with 13 partner organisations such as The University of Melbourne and the Australian Synchrotron. The GTP program has seen more than 2,000 students enrolled in grades 7 to 12 from 33 schools participate in a

diversity of GTP programs since 2008, with 53 completed programs and a school reported retention increase of 90% of girls continuing science studies to Year 12 (GTP, 2019; see also Barone-Nugent et al., 2012). The GTP program supports a positive uptake for girls in science, especially in the study of Physics, which indicates that immersive authentic experiences change the attitudes toward the utility of STEM skills for life choices. By encouraging uptake of all STEM disciplines into the upper years of high school we are ensuring equity of access for girls and boys into career pathways that would otherwise be closed off to them after Year 10. GTP has also been included in Australia's first ever STEM Program Index, a guide to organisations that have programs which encourage STEM engagement in young students (Commonwealth of Australia, 2016).

Students participating in the GTP programs report greater gains in STEM learning and increased enrolment in STEM subjects in Years 11 and 12 when their coursework had an added component of legitimate participation in a scientific community of practice (Barone-Nugent et al., 2012). This phenomenon has been mirrored in similar programs as out of classroom learning activities lead to additional personal and professional benefits such as the ability to take ownership of a project and experiencing the value of team-work in a professional environment. Furthermore, the GTP program experience allows female students to develop STEM and science skills in an authentic learning environ, and to clarify future learning and career goals, leading to increased enthusiasm regarding science when returning to school. This is because the students could see connections to what they were learning and their application in a relevant context. Therefore the students stay connected with, and plan to study, science and STEM subjects (Hutchinson-Anderson, Johnson and Craig; 2015; Thiry, Laursen and Hunter; 2011).

This GTP program method of integrating authentic research into the STEM-specific learning process allows young students to develop a greater understanding of evidence in science and how it is used to construct understanding (Rivera Maulucci, Brown, Grey & Sullivan, 2014). Linking science to real-world situations helps students see the relevance to them in their everyday lives. Giving students an active role in how science is produced allows science to become more accessible. Active involvement rather than passive roles also generates students' sense of agency and informs their future choices to remain engaged in STEM disciplines (Caldwell et al., 2018; Rivera Maulucci et al., 2015; Waldrop, 2015). The GTP program has four tangible STEM-subject outcomes for students that are related to why students (especially girls) do not remain in STEM disciplines, are measurable and are scalable: (a) breaking down of science stereotypes, (b) relating STEM skills and knowledge to real issues, (c) re-

¹ In this manuscript, if not captured within 'STEM', the word 'science' represents the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment, as defined by the Oxford Dictionary.

ating confidence that it is achievable, and (d) promoting understanding of career pathways rather than vocations related to STEM skills. The curriculum framework for GTP programs does not dwell on content concepts but instead highlights engagement, increasing capacity, and opening of life choices which are three essential characteristics to inspire girls' in STEM subject participation (Froschl & Sprung, 2014). Thus out-of-school learning is a way for this to occur while exposing girls to a broad range of career paths, role models and mentors.

Broadening Stem Keeps More Girls Engaged

It is important to acknowledge STEM knowledge and skills are relevant not only to the traditional disciplines of Physics, Maths, Chemistry and Biology, but also are relevant more broadly to other sciences such as environmental, climate, and bio-molecular sciences, and the human sciences such as sociology and psychology. Psychological sciences in particular, while generally regarded (erroneously) as concerning ephemeral human qualities rather than 'science' per se, are increasingly quantifying and qualifying using classical STEM discipline resources to investigate the complex nature of human behaviour and actions. Psychology is defined by the Oxford Dictionary as "the scientific study of the human mind and its functions, especially those affecting behaviour in a given context". In this way, psychology can serve as the mechanism through which we can improve society, with such improvement of society a key motivator for girls taking science-based subjects. Psychology as a discipline is emerging as an interdisciplinary area in which biology, chemistry, and mathematics merge to give insights into how people as a collective and as individuals work. Psychologists can use these important interdisciplinary insights to effect change for societies (Kaufman, 2011), and interdisciplinary learnings in which subject areas are integrated in socially-interactive education increases the likelihood of constructing higher-order thinking skills and knowledge (Capraro and Jones, 2013). In addition, efforts to broaden the knowledge of STEM teachers regarding possible STEM careers – which may not traditionally consider psychology as a STEM-relevant subject – have been found to be effective in increasing the knowledge of STEM teachers specifically (Knowles et al., 2018) which also has implications for students generally. Moreover, secondary female students can be inspired to seek STEM skills when the applications are visible to areas that are of interest to them. Through authentic psychology investigations overlapping with STEM areas to address societal problems while developing analytical skills, scientific literacy, and problem-solving techniques, GTP programs can support more girls to take up STEM subjects at school (American Psychological Association 2009 Presidential Taskforce on the Future of Psychology as a STEM discipline, 2010).

While using the principles of authentic learning outside the classroom in interdisciplinary environments that

demonstrate that STEM-related skills and knowledge are broad and widely applicable with many career prospects, we can inspire more students, especially girls, to study more science at school. This will be in its very essence an important contribution to boosting science literacy and STEM skills in our national interest. In this way, STEM-focused activities are experienced as "an interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy" (Tsupros, Kohler, and Hallinen, 2009 cited in Mohr-Schroeder et al., 2015, p. 10).

Real World Social Psychology GTP Program For Girls

To highlight the interdisciplinary nature of traditional STEM subjects and psychology specifically, an applied social psychology project which operationalised insights from mathematics and physics, biology and psychology in a scientific investigation was developed for the Year 10 girls in the GTP STEM program in 2016. This project provided students the opportunity to experience firsthand how STEM skills lead to real world impact and unexpected career pathways. Year 10 girls who were interested in learning about the role of science in society, but had not necessarily decided to study STEM subjects, study STEM subjects at a tertiary level, or pursue a STEM-related career, were recruited from a local school. This was done by means of a presentation to all Year 10 girls by a Senior Research Fellow in applied social psychology (the first author) describing her career pathway and how science had helped pave the way. Students were asked to apply for a place in a team of students who would participate in the Growing Tall Poppies STEM program for 2016, focusing their application upon the factors that would support their choices for their senior years, career aspirations, and/or potential career pathways.

GTP Participants: Four students submitted completed application forms to the Year 10 Science Coordinator who confirmed that the applications were indeed genuine and that the applicants would benefit greatly – both personally and academically – from participation in the GTP program. Therefore these four girls were selected to participate in the GTP program and were sent an outline for a three day intensive program at the University of the Sunshine Coast (USC). The project was titled "*Helpful Helmets and Cyclist Safety*" and an outline, timeline and student reports can be viewed at GTP (2016).

GTP Procedure: The GTP girls were introduced and became acquainted with the scientists-mentors in the research team composed of female researchers and PhD

students (one male PhD student). Mentors discussed the project brief that outlined their tasks and goals for the three days and incorporated their previous knowledge and inquiries. The program framework had built-in instructional scaffolding, with each step building on previous learning, knowledge and experience, and student-led inquiry that arose during the various steps of the investigation.

GTP Activity Aims: The goal of the research project research was to collect empirical data and use scientific methods to improve our understanding of the observed helmet-wearing behaviour of school children. The rationale for the research emerged from the fact that in Australia helmet-wearing while cycling is compulsory, yet compliance to the law is low for teenagers, and serious injuries – including death – can result from a head injury sustained after falling from a bicycle (Attewell, Glase, and McFadden, 2001).

GTP Activity Method: The GTP girls analysed bicycle-related emergency hospital admissions data for children aged under 15 years riding bicycles, and conducted a preliminary literature review regarding helmet-wearing behaviour by cyclists, to identify gaps in the cyclist-helmet data to reveal what further data would be important in understanding the phenomenon of non-compliance. Research hypotheses were developed based on the findings of the injury data and the literature review. Given the lengthy process of gaining research ethics approval, the USC mentor team had secured approval to conduct the project prior to the commencement of the GTP program. To ensure the GTP girls understood the process involved in conducting a research project more generally, and the critical importance to conduct research in an ethical manner, the process for gaining human ethics approval, and the importance of conducting research ethically, was described as part of the GTP program. The GTP girls actively suggested ethical considerations for the data collection method, which in turn helped inform their input into, and the success of, the data collection process. For example, although they used a data collection template previously developed by the mentor team, the GTP girls brainstormed how they would design the form so that it could be used in an environment where rapid data collection, relying on the researcher's judgement regarding important variables such as age, sex, and helmet position, was required. The GTP girls were guided in the preparation for data analyses through the literature review findings and existing injury data statistics, ensuring that the data analyses were related to the hypotheses that had been developed during this period, and which further refined the design of the data collection template. As part of their preparation, GTP girls also analysed the use of the unobtrusive naturalistic observation method, and were confident in the method's appropriateness for data collection

in this instance. Indeed, the GTP girls reported that the data collection method meant that *'the project is exciting because of this research element.'*

GTP Activity Results: Working as a research team under the mentorship of the USC team, the GTP girls collected observational data regarding the helmet-wearing behaviour of under 15 years' cyclists as they left their school grounds at the end of the school day (Note, this was not the school the GTP girls attended). In the first analysis of their data the GTP girls were surprised to find that there were gender differences in helmet-wearing rates, finding that more girls than boys wore helmets, and more girls than boys wore the helmet appropriately (eg., not simply having the helmet on the head without the chin strap fastened). The GTP girls also noted and discussed some of the difficulties and limitations of the data collection, such as not being able to accurately identify and record cyclist sex as the school students left the grounds en masse. The GTP girls continued their literature searches and data analysis using Excel under the guidance of the scientist mentors, followed by discussions around options for presenting the results of their literature reviews and their data analyses. The GTP girls analysed, discussed and presented their findings on the final day of the GTP activity, addressing research limitations and improvements for future research activities. The GTP girls collaborated by pooling research findings, and developed and rehearsed a conference-style presentation using powerpoint and a poster, which was delivered to science mentors, teachers, and extended university staff and students. During Science Week 2016 the students presented their research findings (serving as a pseudo-evaluation of their engagement with and learning experiences within the GTP program) and their GTP program experiences (serving as a pseudo-evaluation of their engagement with the GTP program) to their school community during school assembly, with two of the members from the university research team attending the presentation to support the students in their efforts.

GTP Activity Reflection by STEM Mentors and Participants: Given the pilot nature of the GTP program at USC, and that the participating university (USC) and the participating high school (Immanuel Lutheran College) previously had not participated in a GTP program separately or in unison, the mentor team were delighted to observe that the students enthusiastically engaged with all aspects of the program. Such engagement ranged from conversing with academics and doctoral students, to conducting the research project which culminated in a presentation before the senior student school assembly. Some quotes from the participants in the program clearly demonstrate the power of authentic experiences in science and how to inspire change in young people regarding what subjects can lead to career pathways rather than set vocations:

"I know before I came that I just thought about science as chemistry, like chemical reactions and chemicals in general. Growing Tall Poppies has really broadened my perspective of science."

"Before this program I hadn't thought very much about sciences as a career pathway, now I have wider range of opportunities for the future."

"This program gave me the amazing opportunity to experience real-life science in a working environment. I have learnt so many new and important things that will help guide my journey into career opportunities and life."

"This program has expanded my knowledge of science further than any school science programs have offered and I am incredibly fortunate to have been given the opportunity to participate in this program. I have learnt new skills that will aid in not only future science programs but other opportunities as well."

While we were unable to determine whether the GTP girls had participated in STEM subjects during the remainder of their senior schooling, or if they had selected STEM-relevant tertiary studies, as the school year had concluded at the time of writing this manuscript, the students indicated that they would consider STEM subjects for their future studies. The (dis)confirmation of this feedback is an important consideration for evaluating the impact efficacy of future GTP programs in instigating and/or retaining interest and/or application in STEM-related fields of study and employment, and should be realised in future GTP programs. In addition, process evaluation of the multitude of programs able to be operationalised through the GTP program, including immersion programs such as the current project, annual symposiums of students with scientists, and interactive workplace curricula for students in Year 10. In this way we can optimise the application and content of STEM-focused programs to achieve the greatest positive impact for young women.

General Discussion: The GTP girls' positive experience was indicated not only in their direct feedback, but was clearly evident in their consistent strong engagement in every aspect of the GTP program activity, ranging from engagement with science mentors to competently and clearly presenting their findings before their peers. The GTP girls built a strong rapport with the science mentors, particularly the younger female mentors. Information regarding female mentor backgrounds and career pathways were also found to make a positive impression upon the GTP girls who had a strong interest in the PhD students and the work they were doing, how this research work exemplified the interdisciplinary nature of sciences and psychology, and how these research projects were relevant to societal issues. The interactive nature of the GTP framework allowed for stereotypes to be challenged,

such as 'scientists are nerdy and have always been brilliant students at school', or that they were 'predominantly old men'. GTP girls reported that they were more likely to enrol in science next year and that they saw the usefulness of the skills they had learnt and had observed in mentors, even when the STEM subjects were not recommended prerequisites for their potential career pathways.

Moreover, firsthand evidence showing that women do, can, and should, do STEM education and employment is powerful (Shin et al., 2016), with this argument clearly apparent in the student feedback noted earlier. The GTP program frameworks are a practical implementation of recommendations, such as from The Australian Council of Learned Academies (ACOLA) that encourages interdisciplinary research with the recommendation for a role model approach where students themselves are able to engage with STEM discipline professionals. When considering how to improve the participation of girls in STEM subjects, access to female role models who can provide an authentic understanding of STEM careers and opportunities is essential (Marginson et al., 2013). All the GTP students commented how having ownership of the project improved the learning experience and enjoyment of the project, which aligns with Smyth et al.'s (2016) findings in research-led education whereby students value their autonomous research capacity. The critical importance of this authenticity is also evident in the earlier quotes. Authentic science inquiry is not simply about knowledge transfer or concept delivery; instead it enables students to ask and investigate their own questions and to communicate their learnings (Caldwell et al., 2018; Rivera Maulucci et al., 2014). The first hand experiences can transform understanding of sciences that are traditionally siloed in school environments, and indeed psychology, and applied social psychology specifically, is often perceived, erroneously, as non-scientific in nature and practice. The GTP outcomes apparent in the 2016 USC GTP program support the work of Rivera Maulucci et al. (2014) and Morales (2010) who demonstrate that students appreciate the diverse skills necessary to do science when they do authentic science inquiry; and the findings of the systematic review of STEM projects targeting youth from preparatory to tertiary schooling by Caldwell et al. (2018).

Finally, student feedback as noted earlier also reveals how influential authentic out-of-school STEM experiences are. The GTP framework is an effective means by which to enact recommendations such as from Bottia, Stearns, Mickelson, Moller and Parker (2015) who advise that increasing the number of students enrolling in STEM subjects at college requires a diversity of STEM experiences at high school so students can connect to STEM experiences, thereby strengthening their interest in STEM subjects. The GTP framework is an effective and scalable means of doing just this if it is implemented widely in the school system to increase the retention of students in the senior years of high school (Barone-Nugent et al., 2012).

Conclusion

The girls who participated in the applied social psychology investigation in the 2016 Growing Tall Poppies program at the University of the Sunshine Coast transformed their understanding of the interdisciplinary nature of STEM skills and knowledge and the research environment. Their stereotypes of the usefulness of science, including psychology, and prevailing gender stereotypes, were actively challenged through an authentic learning experience. The GTP girls found that STEM subjects are required for many fields of endeavour, and that they are achievable without needing to be 'an Einstein'. This paper reveals the importance of tapping into the underrepresentation of women in STEM disciplines to support sustained growth in contributions towards STEM-related fields. The GTP program structures and frameworks have enabled us to implement tangible outreach of our research to inspire students to make a difference in the world and to stay enrolled in STEM subjects at school. Importantly, by engaging students with authentic meaningful investigations in the interdisciplinary sciences, they can engage with and be inspired to study STEM subjects beyond the compulsory years of schooling, to believe they can fit into the STEM 'world', and that they can achieve and can develop meaningful, fulfilling careers in these areas. After all isn't that what we all want to do with our lives?

Acknowledgements

Special thanks to Adolescent Risk Research Unit (ARRU) Research Assistant Dr Tamara Sysak for her contributions towards this manuscript. Special thanks to ARRU Research Assistants Dr Tamara Sysak and Ms Jeanne Dayton, and to ARRU Doctoral students Ms Jamie Caldwell, Ms Natalie Watson-Brown, and Ms Clara Silvi for their mentorship during the University of the Sunshine Coast's 2016 *Growing Tall Poppies* Program.

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Dr Bridie Scott-Parker

Dr Bridie Scott-Parker is the Leader of the Adolescent Risk Research Unit and the founder and Leader of the Consortium of Adolescent Road Safety, based at the University of the Sunshine Coast. She has a strong interest in improving adolescent health and wellbeing in Australia and around the world. Dr Bridie also is a passionate advocate for engaging with young men and women alike, empowering them to optimise their physical and mental health and wellbeing with social and systemic supports as appropriate.



Dr Eroia Barone-Nugent

Dr Eroia Barone-Nugent, an educational expert and Honorary Senior Fellow in the School of Physics at the University of Melbourne, devised and is the Director of the Growing Tall Poppies program. Her areas of expertise include science, secondary science education and curriculum development. Dr Eroia is passionate regarding maximising possibilities for girls within the realms of STEM education and beyond.

