



Creating a Culture of Girls Engaging With STEM: Beginning Early, Mentoring and Careers Advice

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&

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We acknowledge and pay respect to the traditional custodians of
this land - to Elders past, present and emerging, for they hold the
memories, the traditions, the culture and hopes of Aboriginal and
Torres Strait Islander peoples across the nation

Girls' Future – Our Future (2020 Update)

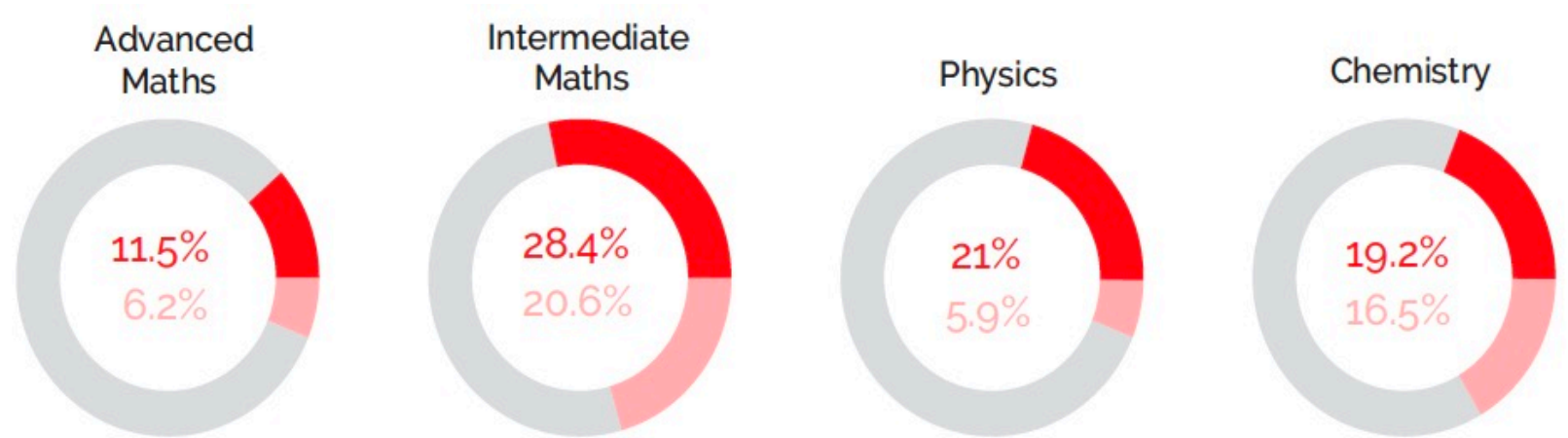
- Research collaboration between University of Melbourne and Deakin University funded by The Invergowrie Foundation.
- Builds on 2017 Invergowrie report that broadly investigated influences on girls' participation in STEM.
- The 2020 report contains three focused investigations:
 - a) STEM in early years (0-8 years) education;
 - b) STEM mentoring and role models; and
 - c) careers advice.



Campbell, C., Hobbs, L., Millar, V., Ragab Masri, A., Spaldewinde, C., Tytler, R., & van Driel, J. (2020). Girls' Future – Our Future. The Invergowrie Foundation STEM Report 2020 Update. Melbourne: Invergowrie Foundation.

Background

- Importance of STEM emphasised in a range of recent research and policy reports.
- At the school level, significant gender differences remain a persistent issue particularly in physics and (advanced) mathematics (Kennedy, Lyons & Quinn, 2014).



Percentage of male (red) and female (light red) students in year 12 advanced and intermediate mathematics, physics and chemistry, 2015. (copied from Kaspura, 2017, p.36, with permission from Engineers Australia).

Background

- Girls have equal or greater achievement scores in both mathematics and science, although girls often do not see themselves as strong in these subjects (Hobbs et al., 2017)
- Gender issues in STEM at the school level received much research and policy attention over last few decades.
- **However, numbers have not improved.**
- Report aims to get to the heart of what can we do.



Identity

- Increasingly influential construct in making sense of girls' response to STEM is that of identity. Identity has been used in many studies (Archer et al., 2010; Tytler, 2014)
- Identity has to do with the way a person perceives themselves as competent, or interested in particular roles, currently or in the future (Calabrese Barton et al., 2013)
- Can shift depending on context, and can be multiple depending on circumstance
- Provides a way of looking at how girls' perceptions of themselves play out over time in relation to STEM subjects, interest in STEM, and future involvement with STEM.



Gender in Educational Settings

- Early childhood (birth to age 8), is a time of emotional, behavioural and cognitive development in a young child.
- During this time, children start to develop the abilities, attitudes, attributes and values that define them. This is their self-identity - who they believe themselves to be.
- A child's identity is shaped by their environment, their values and their unique development.
- It is clear that gendered construction of identity begins very early, and extends to orientations to STEM phenomena, including the creation of interests and perceptions of self efficacy (Baxter, 2017; Fine 2015).
- Prevailing stereotypes have been found to act as barriers that prevent girls from developing interests in STEM.
- Master and Meltzoff (2016) identified two such stereotypes: the cultural fit – the belief that 'maths is for boys', and the 'ability stereotypes' – boys have more ability to do STEM.
- In pre-school, for instance girls are socialized to 'do the right thing' while boys are encouraged to explore more and take risks.





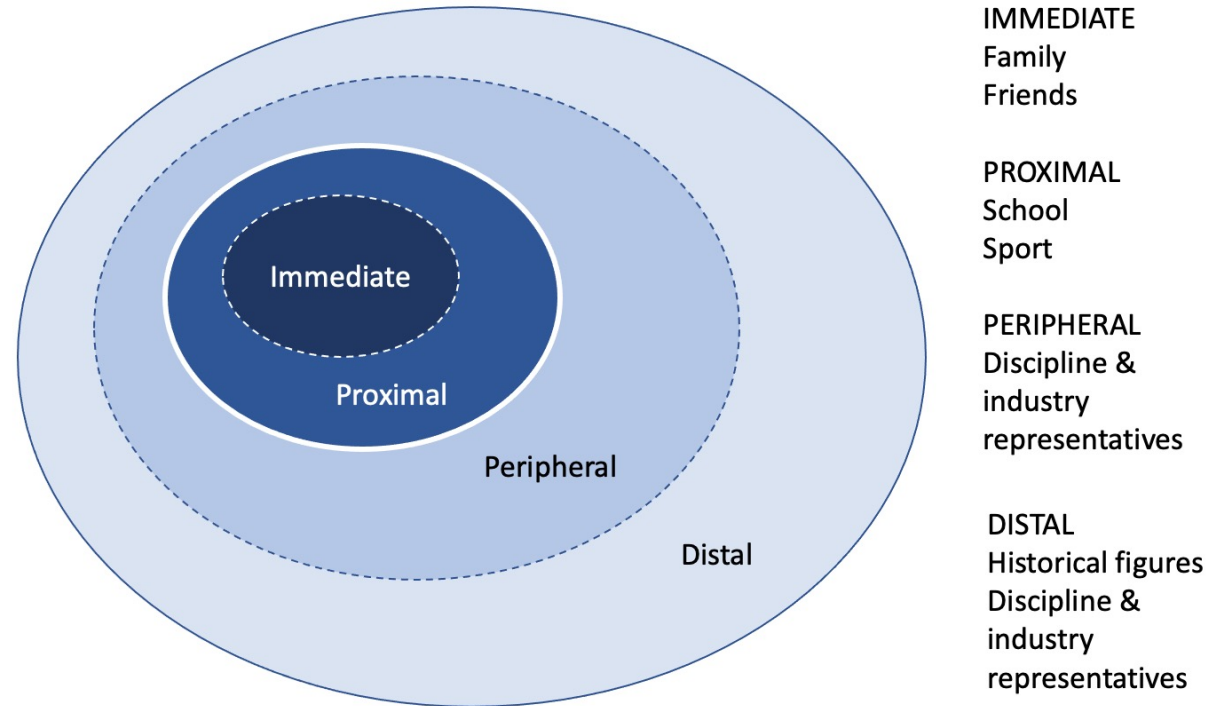
Gender in Educational Settings

- Unconscious biases of teachers need to be challenged, so that they provide equal expectations and opportunities for girls and boys.
- Most teachers are generally aware of social constructions of gender, but some are unaware of how their own views can affect children's interests and achievements.

Can you think of any unconscious biases that you or others you know hold?

Spheres of Influence

Spheres of influence can be seen as shaping wider aspects of girls' gendered identity in relation to their broad interests and responsibilities and future roles, as well as positioning in relation to particular domains such as STEM.



Discuss

How do these Spheres of Influence play out in your educational setting?

How could you recognize and deal with gender biases in your settings?



STEM Mentors and Role Models for Girls

- Review of STEM programs for girls found mentoring was most significant as “these relationships helped young women experience a positive sense of STEM community; in other words, they provided an opportunity to be part of a STEM ingroup” (Kim et al., 2018, p. 609).
- Mentoring relationships can have multiple purposes including:
 - building STEM identities
 - fostering interests in STEM pathways
 - enabling STEM participation through access to networks that the girls may not otherwise have had.

“The biggest thing is just role models, people seeing people that they can relate to, who are doing that, and there’s not one thing called a girl, there are a billion, all with different likes and personalities.” (Matthew, Engineer)



Activities that can connect young people with STEM professionals

Many types of mentors are needed to cater for the variation in girls' interests, personalities and ability.

Relatability to the target audience appears to be a key requirement.

School incursions **OR** Excursions

Ambassadors

Off-site visits to businesses

'Light' Meet and greets **OR** Deeper engagement

Invited speakers

CSIRO

Student focused activities **OR** New curriculum

GALS

Industry-informed projects

School initiated **OR** Family initiated

Sustainability lunch group

Family games night

School-leaver focused **OR** Younger students

Careers nights

Maker spaces

Superstars of STEM **OR** Grassroots stories

Future Leaders

Local farmer

Discuss

What do you think is possible at your school?

School incursions **OR** Excursions

'Light' meet and greets **OR** Deeper engagement

Student focused activities **OR** New curriculum

School initiated **OR** Family initiated

School-leaver focused **OR** Younger students

Superstars of STEM **OR** Grassroots stories

Careers Educations

- Majority of young children, both boys and girls, show positive attitudes towards science at age 10, however, interest in science declines by the age of 14 after which their interest and attitude towards science has been largely formed (Archer et al., 2010).
- Evidence that many students form ideas about careers from an early age (Broadley, 2015).
- PISA 2015 showed that girls (Year 9) were three times less likely to expect to work in science and engineering professions than boys when asked what career they expect to be doing at the age of 30 (Thomson, De Bortoli, & Underwood, 2017, p. 244).
- Schools tend to offer careers advice to students age 14 and older.
- Careers advice offered in Australian schools is generally patchy, inconsistent, and of varying quality and quantity (Norton et al., 2019).
- The median time spent per student on careers advice in secondary school is 2 hours. Of this time, 82% is spent on year 10 – 12 students (Dandolo Partners, 2017).



Careers Education – call to action




- Primary school focus – practical ideas for doing this
- Given the evidence that girls are subtly pushed away from STEM from an early age, it is possible that girls are less likely to identify an interest in STEM due to years of this messaging. This then leads to girls not being provided with advice on pursuing STEM.
- Literature stresses the importance of career knowledge and awareness among school students as young as primary and middle school (Broadley, 2015)
- Need to tackle ingrained gender and career assumptions at an early age, while not without challenge, is essential (Coughlan, 2019).



Discuss

How can careers awareness
and education be integrated
across educational settings?



Girls As Leaders in STEM - GALS

Aims to

- Equip teachers with STEM understandings through STEM PL
- Improve girls' engagement in STEM, entrepreneurial thinking and leadership.
- Develop girls STEM capabilities by working closely with other GALS participants, women in STEM and STEM leadership in industry-based projects.
- Change local culture and societal expectations
- Develop girls as STEM leaders within their schools
- Develop curriculum materials through collaborative engagement of all partners
- Undertake research to develop and enhance pedagogy and practice



How?

- PL for teachers & active involvement in STEM Conference
- GALS industry-based projects – including 3 days at Deakin
- School Celebration event
- Public Launch and public display of projects

Problem Card: 4 Managing Waste

Girls as Leaders in STEM

GALS

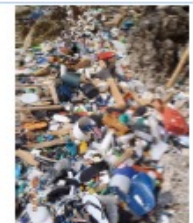
Victorian
Fisheries
AUTHORITY



What do you do with an empty bottle? Does your school encourage Nude Foods? There is a lot of talk about plastics being bad but are there any good plastics? If we look around, plastics have become a part of nearly every aspect of our lives. There is a lot of attention about inappropriate disposal of plastics as a threat to marine animals and the importance of recycling or collecting as a solution. But is recycling and landfill the only option for dealing with waste? Have we thought about how much energy is needed to turn one bottle into something else? The phase Reduce, Reuse, Recycle has been updated to Refuse, Reduce, Reuse, Recycle but in some cases we skip straight to recycle. Waste is a big problem and it's just getting bigger – so what are the options?

Marine Debris - Australia State of the Environment Report 2016

Within the marine environment, marine debris comes from both the land (rubbish flushed out to sea) and marine industries (loss of equipment, often from fishing operations). Although marine debris can be found in all areas of the marine environment of Australia - Northern Australia is especially vulnerable because of how close it is to intensive fishing operations (including international operations) and ocean circulation and wind patterns that make it easy for floating debris to collect.



Sources,
distribution
and fate of
marine debris-
CSIRO

CSIRO research has shown that approximately three-quarters of the rubbish along the Australian



Recommendations

PARENTS:

- Program for parents
- Gender neutral resources (expectations and language)
- Websites with resources and activities for parents, interactive

PROFESSIONAL LEARNING:

- Early childhood and lower primary school
- Leverage the expertise and influence of existing resources (eg. Primary Connections)
- Training for teachers to work with STEM professional and industry representatives
- Initiatives aimed at careers / STEM teachers to increase STEM and gender awareness

EVALUATION:

- Support schools to generate data on their own initiatives
- Support schools to employ evaluators or researchers to generate evidence of impact
- Showcase high quality examples with evidence of impact

MENTORING PROGRAMS:

- Contextualised interactions between girls and mentors within tasks
- Multiple touchpoints
- Leadership training for girls
- Teachers share their STEM experiences from industry

CAREERS ADVICE:

- More research is needed, however, this is a hard area to access
- Initiatives to address the lack of policies, e.g., around qualification and for **careers advice for students below year 10**
- Grass roots initiatives



Collate your ideas

- What recommendations can you take back with you?



Conclusion

- Not every girl (or boy!) needs to pursue a STEM pathway, but their upbringing and education should provide them with opportunities and access to information that help them to make informed career choices about STEM in relation to their future, that are not biased by ideas of what girls can and can't or should or shouldn't do.
- This can only be achieved if educators, parents, and other stakeholders that influence girls' decisions are aware of their own biases and limits
- <https://www.invergowrie.org.au/2020stem/#>



The
INVERGOWRIE
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GIRLS' FUTURE – OUR FUTURE

The Invergowrie Foundation
STEM Report – 2020 Update



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