Lillian Everitt
Lillian.Everitt@uni.canberra.edu.au

WHAT HAPPENED TO THE "T" IN STEM?

Lillian Everitt, Eddi Pianca
Faculty of Arts and Design, University of Canberra, Canberra ACT

Abstract

This paper explores issues of gender within "Technology Education", specifically current technologies and the support for teaching approaches to traditional curricula in technology education, industrial technologies and tool technology. If we are to achieve more from our students and to expect that their contribution be based on creativity, innovation and design cultures, then teacher education and professional development needs also to be creative and innovative in its execution of curriculum and professional development.

It is argued that the recruitment and promotion of female students within the domains of Science, Engineering, Technology and Mathematics (STEM) is critical if we are to promote a future workforce based on gender equity and the maximising of our human resources. Within Technology Education females are also in the minority.

Technology education needs to be systematically inclusive of female students, rather than by invitation or *ad hoc* into these traditional male domains. There is a need for both trainee teachers and in-service teachers to be trained and supplied with gender equity material and training frameworks (Sanders & Tescione, 2004). Just as it is applicable within digital technologies, it is argued that it is critical within tool technologies. We must recognise that, just as half of our student body are female, so they are in society, with growing numbers participating within the workforce. We need to resolve gender imbalances across roles in all industries (Poynton & Rolland, 2013). The core issue is that female participation has fallen short within technology and within STEM more generally, and the issues are closely related. Finally, we argue that teacher education and teacher professional development is imperative in addressing low female participation rates.

Introduction

In STEM, the "T" for "Technology" hides in the shadows. STEM within Secondary education must focus on all the categories of "S T E M" if it is to succeed!

The conversation needs to be raised about Technology being the poor cousin next to science and maths. This paper does not wish to detract from the importance of science and maths. Rather, for the purposes of this paper, the focus is on "technology education" which is inclusive of computing, information, digital technologies and robotics, while specifically remembering that tool technologies are an intrinsic part of engineering and manufacturing.

Furthermore, while technology lies in the shadows for all students, it lies in deeper and darker shadows for female students. The issue is that for more than 30 years, participation rate of girls and women in technology education has been substantially lower than that of males. The struggle with female stereotyping is that it is intertwined with image, and specifically by the way that it is commonly perceived by students that women cannot participate on an equal footing within these technology domains (Lynch, 2007).

Recognition and political and economic support are essential if the future of STEM education is to succeed. More importantly, we must recognise that in employment and manufacturing domains within the 21st century, success will ride on the back of a successful, equitable STEM education program. The goal should not be only to increase participation rates but in fact to maximise female participation in

Lillian Everitt
Lillian.Everitt@uni.canberra.edu.au

these domains, ultimately leading to our education system producing a workforce based on knowledge and skill which forms a “creative culture” (Cox, 2005; Robinson, 2008) for all technology and engineering domains within STEM. Thus, this research is focused within the secondary school domains, specifically year 11 and 12. Finally, the fact remains that the rate of female participation within technologies and STEM has decreased within Australia and many other Western countries in the last decade.

Recognition of the problem

It is widely recognised and acknowledged by research and governments alike, that female participation rates in some of the key areas of STEM have decreased or remained static over the last decade. The issues relating to these low female participation rates within technology education must be acknowledged, and are predominantly based in ongoing cultural restraints.

Technology education and the meaning of “technology” in this instance is viewed as meaning the knowledge of techniques, processes, and skills that can be embedded in computers, digital devices, electronics and robotics. Tool technologies are an intrinsic part of engineering and manufacturing. The knowledge and skill within technology is often defined as a “collection of processes and methods used in the production of goods or services or in the accomplishment of objectives, such as scientific investigation” (Wikipedia, 2015); or designing and manufacturing “components … that fit within small or large systems that are products from an idea that is used within the marketplace. Anything from microscale sensors and inkjet printer nozzles to large systems such as spacecraft and machine tools” (Columbia University, 2012).

Industrial designers and product designers will often find themselves working closely with mechanical and electrical engineers. Let us not forget that tool technology still sits at the core of manufacturing and the engineering industries. The concern raised here is that, notwithstanding the importance of computing, information, and digital technologies, the fact is that 3-D printers, CNC tools, and laser cutters do not serve to answer all our manufacturing needs. The reality is that certain processes within manufacturing, e.g. manufacturing of disc brakes in car manufacturing, will dictate the need to still have more traditional activities such as toolmaking and die casting as part of the manufacturing process. Moreover, the unit cost of products still remains a significant factor in manufacturing production; thus our reliance within these domains will still require tool technologies being included within Computers and Information Technology (CIT) education.

The very nature of these technologies have demanded, on multiple levels, a highly skilled workforce, just as the industrial revolution made “astonishing leaps in technology and the emerging of new materials and the world of electrics” (Kimbell, 2013). The changing demographics and the exponential and diverse growth of technologies have meant that education, whether vocational or postsecondary, must be both proactive and engaging. Therefore the goal is “to improve practices so that teachers can better help these students graduate from high school ready to succeed for their working lives beyond secondary school vocational and postsecondary education” (Cantrell & Kane, 2013) and “are founded on creating equitable value for all people to be able to participate in productive lives” (Cantrell & Kane, 2013). Yet female participation rates are in fact declining in technology subjects (CIT, engineering, tool technology, science, maths) suggesting that female students are still failing to be adequately challenged in order for them to create successful pathways to these learning domains, which has become an enduring problem (Lynch, 2007; Weber, 2009).

Gender within technology education: The question of recruitment and promotion of female students

The fact is that the issues relating to female participation within STEM education and specifically technology education has now returned to the forefront of importance for policy makers within this

Lillian Everitt
Lillian.Everitt@uni.canberra.edu.au

country. Research has shown clearly that Australian student expectation of participation within STEM is still lower than its western counterparts (Marginson, Tytler, Freeman, & Roberts, 2013 p135).

The low participation rate of females in STEM in Australia is partly illustrated by the following data for Queensland, for the three subjects Technology Studies, Engineering Technology, and Information Processing & Technology, for the period 2008-2014 (Queensland Curriculum & Assessment Authority, 2008-2014). Female participation rates are around 10% in technology studies and in engineering, and around 15% (and decreasing) in information technology.

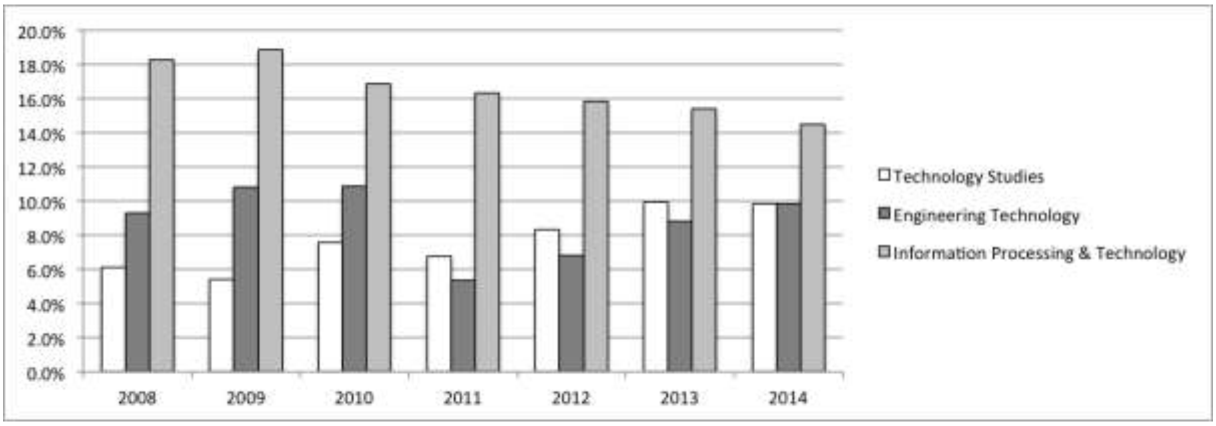

Figure 1. *Queensland: Female enrolments as a percentage of total enrolments in Technology Studies, Engineering Technology, and Information Processing and Technology 2008-2014*

Students, and female students in particular, have had limited exposure to technology subjects within the current school setting from K to year 8. Choices for elective subjects thereafter is the norm. Middle school is a critical time for subject choice for students in ensuring that they are coming from a position of knowledge in the selection of elective subjects which provide future career paths that will lead into future labour markets. What is paramount here is that, for females to participate equitably within these domains, they must have knowledge of the elective subjects, and the merit attached to them.

Subject enrolment numbers and choices within CIT, engineering and tool technologies such as metal and wood construction and manufacturing have only maintained the gender discrepancy. Vickers and Ha (2007, p. 38) state that in senior secondary level within CIT subjects students are “dealing with … a curriculum as they imagine it to be ... Based on their experience in the primary and junior secondary years, students create their own constructions about each particular subject.” We argue that positioning all our students with early exposure to “technology education”, with an emphasis in this instance on tool and engineering education, can only support the building of skill and knowledge for students in these subjects. Students who are provided with learning which is of value, and who are also instilled with value within themselves, cannot but rise to the occasion of success. Empowerment of knowledge and skills with creativity can only lay a foundation for students that shows them the connectedness of the world and things around: this process will produce greater dividends in early secondary school years “creating intersection between self-concepts, values with the links between beliefs and choices in high school” (Simpkins & Davis-Kean, 2005).

Having students who can make the strongest choices for themselves is a powerful tool, particularly if the students are not fearful about thinking outside of the square. Hall, Dickerson, Batts, Kauffmann, and Bosse (2011) state that “Numerous studies have been conducted on factors influencing student’s choice of major ... Studies have identified personal interest as a key factor” providing students with empowerment in future subject selection.

Industrial technology teachers are only too often confronted by students having very little or no knowledge of which subjects they would like to choose in the latter years of secondary education. This dilemma frequently leads to poor elective subject selections that are frequently made either by

Lillian Everitt
Lillian.Everitt@uni.canberra.edu.au

timetable convenience or parent's knowledge and experience, peers, friend's teachers and even media exposure of females in these domains.

The dilemma faced by students, but one could argue particularly female students, is that the pressure and restraints of family and community perceptions of what the appropriate future work should be for them often contradicts how students view themselves, and their image of how they could excel within a non-typical domain. Female students often have little or insufficient support from teachers and school counsellors in the current framework. Female students are frequently encouraged into a more stereotyped gender-based selection by poorly advised school counsellors. Vince Ball from the Construction Industry Training Council believes that having female mentors from the industry has shown, within the Wood Construction Industry, to be a very positive and a supportive intervention (personal communication, July 2015). School counsellors are often poorly informed themselves and thus not able to provide students, particularly female students, with in-depth knowledge of typical industries.

The real issue is to be able to provide the knowledge and experience for female students within the technology classroom environment so that they are able to understand the link between Technology Education and future learning and careers within STEM (Lang, Craig, Fisher, & Forgasz, 2010).

Lang et al. (2010) have reported on a program called "digital divas" - the aim of the program is not only to scaffold positive participation and encouragement within the digital environments by female students but also to provide informal role models and mentors within this domain for secondary students. This breaks the cycle of lack of knowledge and stereotypical influences, instead guiding students in their decision-making process (Congressional Research Service, 2006; Paldy, 2005).

Within the traditional tool technology domains, it is envisaged that a similar program could be implemented within the standard secondary school environments to encourage females to re-examine their views of these traditional domains and also recognise how these domains are moving forward with the support of technology in directions that previously were unimaginable. Hall et al. (2011) state: "Numerous studies have been conducted on factors influencing student's choice of major … studies have identified personal interest as a key factor". Irrespective of gender, students frequently base their decisions in early secondary schooling on factors such as parent's knowledge and experience, friends, peers, teachers, school counsellors and not least of all media's portrayal of gender in such industries as technology, engineering, industrial design and product design.

International and local perspective

Australia is a global citizen: its international counterparts all seek the same goal - that a country's successful education program sits as the backbone of strengthening a nation's economic growth and well-being of its people and nation (Marginson et al., 2013 p59). International organisations such as UNESCO, the OECD, the World Bank, and the EU are all working to the same agenda, which is to catapult STEM education well into the 21st century globally, inclusive of increased female participation (Marginson et al., 2013, p. 134).

Just as the world was hit with a wave of dramatic change during the industrial revolution, so again it has been overwhelmed with such exponential growth of STEM in the technology age, so much so that the ordinary global citizen is being challenged to participate within the new paradigm of this technological age. Moreover, no country can stand alone, nor its citizens. Many research reports have identified that economic modelling has consistently identified a relationship between direct measures of cognitive skills and long-term economic development (Barro, 2001; Krueger & Lindahl, 2001; Marginson et al., 2013; OECD, 2010b; Sianesi & Reenen, 2003).

The participation of females in technology education within the fields of STEM and technologies industries, in the Australian context, is still low (Marginson et al., 2013). Moreover, cultural gender

Lillian Everitt
Lillian.Everitt@uni.canberra.edu.au

perceptions that are anchoring female students in identifying with traditional work roles have not been broken down as anticipated. With the exponential growth of CIT, digital, robotic and related technologies, there has been a refocus on furnishing new growing labour markets which are STEM-related for future and current industry and manufacturing. (West, 2012) states: "STEM education can deliver value to the Australian economy by preparing STEM students for a range of careers.". He further states that "Innovation, particularly through the application of science and technology, is central to maintaining productivity, economic growth, and our standard of living." The challenge is to create an environment within secondary schools that is based on encouragement, and which is anchored in fostering and developing the confidence of all students, and of female students in particular. For all students, the ability to embrace learning and to be motivated by a passion for new technologies is critical.

In the USA, the Obama administration seriously committed to providing students with the knowledge and skill base required to excel within STEM and technology. The Obama administration launched an initiative in 2009 to "move American students from the middle to the top…." (National Science Board, 2009). Moreover, they are preparing 100,000 new and effective STEM teachers over the next 10 years and the administration is broadening participation to create greater diversity of talent within STEM.

Similarly, China and many other Asian countries such as Malaysia, Singapore, Vietnam and Japan are moving forward in the same direction, as are European nations such as the UK, Russia, Poland and a number of South American countries. Within this context, many of these nations are recognising the need to focus on unrepresented groups and increasing engagement and broadening participation of girls and women alike (National Science Board, 2009; OECD, 2006).

The differing expectations between 15-year old males and females regarding their expectations regarding a science-related career within computer sciences and engineering by the age of 30 are given in Figure 2, based on OECD data (OECD, 2010a). The OECD average female percentage is low at 12.4% - the corresponding Australian percentage is even lower at 8.4%.

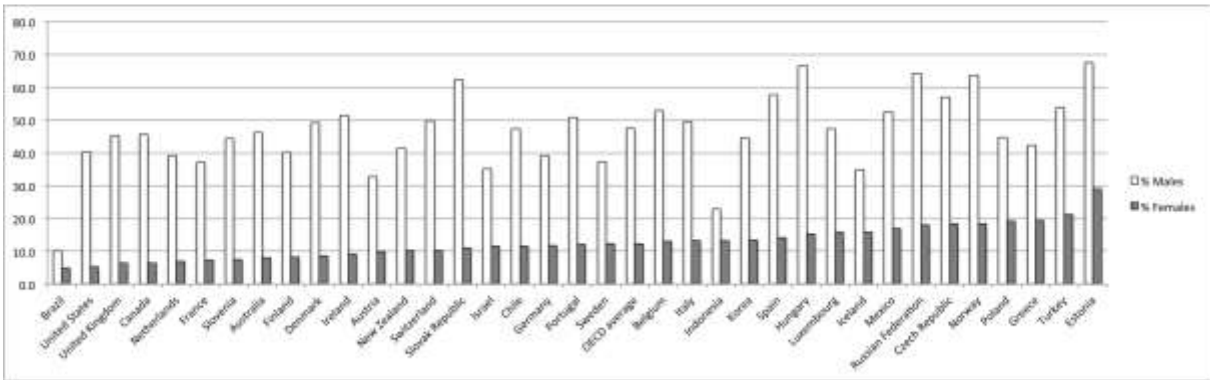

Figure 2: The percentage of 15 year old students expecting a science-related career at age 30: Computer Sciences and Engineering

The following is the key finding from the American Association of University Women report (Hill, Corbett, & St. Rose, 2010):

> As well as tracking between STEM and non-STEM, most countries track between academic and technical-vocational sectors in secondary and/or tertiary education. This is especially true in countries with strong manufacturing sectors and/or technologically-based services. While this sectoral divide is not identical to the STEM/non- STEM distinction within a single school sector, the secondary-technical sector is usually a STEM heavy sector with a focus on applied engineering and related knowledge and skill.

Lillian Everitt
Lillian.Everitt@uni.canberra.edu.au

Teacher education and professional development: Links between creative and innovative teaching of "Technology Education"

> There are no short-cuts here. Students need to acquire these contents in solid programs of study taught by teachers qualified in the specific discipline. This is a key issue and problem in Australian schooling, particularly in relation to mathematics. … Further, contents acquired at secondary school are an essential foundation for later learning. (Marginson et al., 2013)

It is recognised that to enrich teaching and student outcomes, one must have schools that are supportive and foster "Good Teaching" practice as the cornerstone for excellent teaching and performance. Murphy (2013) states that there is an opportunity to "shape teacher evaluation and development to improve standards and reduce in-school variations between subjects and between pupils of different backgrounds". Supporting teachers needs to be based on a "correlation between effective monitoring and evaluation of teaching which is central to continuous improvement of the effectiveness of teaching in school" (OECD, 2009, 2010b)

This paper makes the following recommendations on ways to enrich teaching and student outcomes:

- "Trainee teachers and in-service teachers to be trained and supplied with gender equity material and training frameworks" (Sanders & Tescione, 2004). Moreover, both trainee teachers and in-service teachers must be provided with a strong basis of knowledge of subject matter and skill, supported with ongoing professional development. The desired outcome is that all students are able to develop innovative, creative and problem-solving knowledge and skills which build on prior knowledge and lay a foundation for future knowledge.

- Teachers being actively involved in building networks of educational and professional mentors for female students who wish to pursue career path within STEM and specifically CIT and heavy technologies inclusive of engineering.

- Teachers have an obligation to operate within a paradigm of high standards. These standards are not only the professional standards for teachers provided by Australian Institute for Teaching and School Leadership (AITSL); rather, committed teachers know their students. Designing and implementing classwork run investigation, problem-solving and self-directed tasks provides a challenging set of learning goals and supports student engagement, driven from an innovative and creative direction (Felder, Woods, Stice, & Rugarcia, 2000).

- Problem-based learning: Relevance, resource constraints, and comfort level is critical when teaching heavy technologies and engineering subjects (Felder et al., 2000). It is also important to encourage students to work in small groups to obtain a solid start and develop their confidence (Froyd, 2002; Johnson & Johnson, 2000).

- Encouraging students to work in a collaborative, holistic environment which creates connectedness to authentic learning environments where clear and appropriate goals are set (Algert & Froyd, 2003; Johnson & Johnson, 2000)

- Curriculum content that is inclusive and recognises student learning differences and styles that specifically recognise a feminist perspective. An increased focus on inquiry-based teaching through curriculum (Marginson et al., 2013).

- Providing workshop environments, instructional material and usability of tools and machinery that is inclusive of all students irrespective of skill, knowledge, gender or culture.

- Creating educational platforms which provide young female students with detailed knowledge of possible career paths that respond to labour markets, based within a creative, imaginative and passionate focal point.

- "Classroom observation for teacher development: Even when conducted by well-trained independent evaluators classroom observations are the least predictive method of assessing teacher effectiveness" (Murphy, 2013).

- Departments of Education should collect and provide ongoing data about student participation, and continuing into further technology education through evaluation and development of ongoing improved standards.

Conclusion

It is well recognised nationally and internationally that the extraordinary exponentially rapid changes of the latter 20th century and early 21st century has brought with it a focus on the domains of technological and STEM environments. Yet within these ever-changing environments there is a tension between the old technologies and new technologies. With that in mind, the current education setting must focus on new technologies and the old to move forward hand-in-hand to support these new industries. We are not manufacturing everything via 3D printing.

In the context of this paper, there are disappointing levels of females who remain at risk of exclusion of these new industries. Our challenge remains that the number of female students undertaking STEM subjects in year 11 and 12 has declined. For the purposes of this paper, specifically computer science, industrial technologies and engineering, though this can also be inclusive of mathematics or such subjects as physics and chemistry. Moreover, it has been found that female participation within STEM VET subjects was also low in numbers (Queensland Department of Education, 2007).

In an age of job specific skills dictated and driven by the advances of technology, our students will need to be adaptive, creative, and skilled to be included within this new labour market. Thus, the writer contends that the call for proactive policies and strategies to be gender friendly and inclusive lies at the core of a homogenous inclusive society; policy makers of both sides of the fence need to adapt to a no-fault policy of not blaming the other side and of moving forward with the systematic coherent national curriculum (ACARA, 2013). The development of the new year 11 and 12 technology curriculum should have a strong feminist perspective in order to maintain equity and access of gender. What we cannot afford to do is be sluggish in our support for the national "technology curriculum" (year 11 and 12). Let's hope that our policymakers on both sides of the political fence adhere to the fact that many of our international counterparts are already moving forward in this direction of a national curriculum that is supportive of technology education and inclusive of female participation on an equal footing, for we cannot afford to be left behind in the economic global arena. As Marginson et al. (2013 p137) state: "Australia is well below the OECD and EU21 averages in engineering, manufacturing and construction, sciences, life sciences and mathematics".

Future areas of work to be examined should be the low female enrolment rates in CIT technology, heavy industrial technology and engineering VET related courses, examining how to support those students wishing to go into these domains, but equally how to support those students wishing to go on to industrial design, product design, architecture, mechanical engineering, electrical engineering and civil engineering in University.

Lillian Everitt
Lillian.Everitt@uni.canberra.edu.au

References

ACARA. (2013). Draft Australian Curriculum: Technologies. 1 March 2013, from http://consultation.australiancurriculum.edu.au/Static/docs/Technologies/Draft Australian Curriculum Technologies - February 2013.pdf

Algert, N. E., & Froyd, J. E. (2003). Effective Decision Making in Teams. http://foundationcoalition.org/publications/brochures/effective_decision_making.pdf

Barro, R. J. (2001). Human Capital and Growth. *American Economic Review, 91*(2), 12-17.

Cantrell, S., & Kane, T. J. (2013). Ensuring Fair and Reliable Measures of Effective Teaching: Culminating Findings from the MET Project's Three-Year Study. http://metproject.org/downloads/MET_Ensuring_Fair_and_Reliable_Measures_Practitioner_Brief.pdf

Columbia University. (2012). What is Mechanical Engineering? Retrieved 15 August 2015, from http://me.columbia.edu/what-mechanical-engineering

Congressional Research Service. (2006). Science, technology, engineering, and mathematics (STEM) education issues and legislative options *CRS Publication No. RL33434*. Washington, DC, USA.

Cox, G. (2005). *Creativity, Design and Business Performance*. (DTI Economics Paper No 15). UK Dept. of Trade and Industry: Retrieved from http://www.dti.gov.uk/files/file13654.pdf.

Felder, R. M., Woods, D. R., Stice, J. E., & Rugarcia, A. (2000). The Future of Engineering Education. II. Teaching Methods that Work. *Chem. Engr. Education, 34*(1), 26-39.

Froyd, J. E. (2002). Getting Student Engineering Teams Off to a Good Start. http://foundationcoalition.org/publications/brochures/Starting_Teams.pdf

Hall, C., Dickerson, J., Batts, D., Kauffmann, P., & Bosse, M. (2011). Are we missing opportunities to encourage interest in STEM fields? *Journal of Technology Education, 23*(1), 32-46.

Hill, C., Corbett, C., & St. Rose, A. (2010). Why so few? Women in Science, Technology, Engineering, and Mathematics. http://www.aauw.org/files/2013/02/Why-So-Few-Women-in-Science-Technology-Engineering-and-Mathematics.pdf

Johnson, D. W., & Johnson, F. P. (2000). *Joining Together: Group Theory and Group Skills* (7th ed.). Boston, MA: Allyn & Bacon.

Kimbell, R. (2013). The 'Pleb' Paradox. *Design and Technology Education: An International Journal, 18*(2).

Krueger, A. B., & Lindahl, M. (2001). Education for growth: Why and for whom? *Journal of Economic Literature, 39*(4), 1101-1136.

Lang, C., Craig, A., Fisher, J., & Forgasz, H. (2010). *Creating digital divas: scaffolding perception change through secondary school and university alliances*. Paper presented at the Fifteenth annual conference on Innovation and technology in computer science education, Bilkent, Ankara, Turkey.

Lynch, J. (2007). Exploring the gender and IT problem and possible ways forward In J. Lynch (Ed.), *Gender and IT: Ongoing challenges for Computing and Information Technology Education in Australian Secondary Schools* (pp. 1-27). Altona, Vic: Common Ground and Curriculum Corporation.

Marginson, S., Tytler, R., Freeman, B., & Roberts, K. (2013). STEM: Country Comparisons. http://www.acola.org.au/PDF/SAF02Consultants/SAF02_STEM__FINAL.pdf

Murphy, R. (2013). Testing teachers: what works best for teacher evaluation and appraisal. http://www.suttontrust.com/wp-content/uploads/2013/03/MURPHYTEACHEREVALUATION-FINAL.pdf

National Science Board. (2009). STEM Education Recommendations for the President-Elect Obama Administration. http://www.nsf.gov/nsb/publications/2009/01_10_stem_rec_obama.pdf

OECD. (2006). Evolution of student interest in science and technology studies: Policy report. http://www.oecd.org/science/sci-tech/36645825.pdf

Lillian Everitt
Lillian.Everitt@uni.canberra.edu.au

OECD. (2009). PISA 2009 Assessment Framework: Key competencies in reading, mathematics and science. http://www.oecd.org/pisa/pisaproducts/44455820.pdf
OECD. (2010a). Expectations for Science-Related Careers by Gender. In OECD (Ed.), OECD Factbook 2010: Economic, Environmental and Social Statistics. Paris: OECD Publishing. doi: http://dx.doi.org/10.1787/factbook-2010-67-en
OECD. (2010b). The high cost of low educational performance: The long-run economic impact of improving PISA outcomes. Paris: OECD Publishing.
Paldy, L. (2005). No time for complacency. *Journal of College Science Teaching, 35*(3), 4-5.
Poynton, A., & Rolland, L. (2013). Untapped opportunity: The role of women in unlocking Australia's productivity potential. Ernst and Young, Australia.
Queensland Curriculum & Assessment Authority. (2008-2014). Statistics: Enrolments and levels of achievement. Retrieved 2015, from http://www.qcaa.qld.edu.au/617.html
Queensland Department of Education, Training and the Arts. (2007). Towards a 10-year plan for science, technology, engineering and mathematics (STEM) education and skills in Queensland: Discussion paper http://education.qld.gov.au/projects/stemplan/docs/stem-discussion-paper.pdf
Robinson, K. (2008). The other climate crisis: Digital culture, demography and education: Media International Australia.
Sanders, J., & Tescione, S. (2004). Equity in the IT Classroom. from http://www.josanders.com/portal/index.htm
Sianesi, B., & Reenen, J. V. (2003). The returns to education: Macroeconomics. *Journal of Economic Surveys*, *17*(2), 157-200.
Simpkins, S. D., & Davis-Kean, P. E. (2005). The intersection between self-concepts and values: Links between beliefs and choices in high school. *New Directions for Child and Adolescent Development*, 31-47. doi: 10.1002/cd.148
Vickers, M., & Ha, M. T. (2007). The imagined curriculum: Who studies Computing and Information Technology subjects at the senior secondary level? In J. Lynch (Ed.), *Gender and IT : ongoing challenges for computing and information technology education in Australian secondary education*.
Weber, K. (2009). Determining progress toward achieving equity (2nd ed.): International Technology Education Association.
West, M. (2012). STEM Education and the Workplace. *2012*(4). http://www.chiefscientist.gov.au/wp-content/uploads/OPS4-STEMEducationAndTheWorkplace-web.pdf
Wikipedia. (2015). Technology. Retrieved 15 August 2015, from https://en.wikipedia.org/wiki/Technology