australasian journal of TECHNOLOGY EDUCATION

The Australasian Journal of TechnologyEducation is a peer refereed journal, and provides a forum for scholarly discussion on topics relating to technology education. Submissions are welcomed relating to the primary, secondary and higher education sectors, initial teacher education and continuous professional development, and general research about Technology Education. Contributions to the on-going research debate are encouraged from any country. The expectation is that the Journal will publish articles at the leading edge of development of the subject area.

The Journal seeks to publish

- reports of research,
- articles based on action research by practitioners,
- literature reviews, and
- book reviews.

Publisher: The Technology, Environmental, Mathematics and Science (TEMS) Education Research Centre, which is part of the Faculty of Education, The University of Waikato, publishes the journal.

Contact details: The Editor, AJTE, pj.williams@waikato.ac.nz

Cover Design: Roger Joyce

ISSN: 2382-2007

australasian journal of
TECHNOLOGY EDUCATION

Volume 1, 2014

australasian journal of TECHNOLOGY EDUCATION

Volume 1, 2014

Theoretical Implications of Gender for Technology Education

Vicki Knopke

Abstract

This paper explores issues of gender as they relate to secondary school technology education in recent decades. It examines the theoretical issues that have shaped gender participation and engagement in this area of learning over time and concludes with recommendations for Australasian educators.

Since the 1970s, there have been efforts to address the stereotyping of areas of learning according to gender, with technology being a prime example of an area that has often been regarded as a male-only activity. However, more than forty years later, female students are still engaging in school studies that were traditionally regarded as gender specific, as are boys.

This examination is concerned particularly with post-compulsory students. These are students in Years 10, 11 and 12 and those ready to make the transition from school to other learning and work pathways. Three orientations – the biological, socialisation, and cognitive/ ecological approaches – are examined with respect to students in technology education classes.

Key Words: Gender, technology education, values, ecology.

Introduction

This paper explores issues of gender related to technology education in recent decades and examines theoretical issues that may shape gender participation and engagement in the post-compulsory schooling years within the context of technology education for Australasia. The paper will define the area of the study, examine the theoretical issues and conclude with recommendations for advancing the study of gender within technology education.

In the United Kingdom and United States in recent years, much has been written about technology education in the areas of design and technology and technological literacy. Research about values, beliefs and cognition has been undertaken in Australia. The general development of technology education and beliefs has emerged from New Zealand (Williams, 2011). In a meta-analysis of research, Williams noted the most common topic was design, followed by curriculum, technological literacy, thinking and pupils' attitudes toward technology led by teaching, learning, values and beliefs. Research trends have been around design, curriculum and technological literacy followed by thinking and concerns about the STEM (science, technology, engineering and maths) areas related to technology.

Gender as related to Education and Technology Education

A review of recent Australasian literature reveals research on pedagogy in technology education in the early childhood and junior school areas (Fleer & Jane, 1999; Ford, 2011). Middleton (2008) has written on design and technology, and Pavlova (2009) has researched values and sustainability. Fox-Turnbull's (2010) work on effective conversations in classrooms contributes to discourse in technology education that has a gender bias. Similarly, the works of Foster (1996) and King (Foster, 1996; King, 2003,) have investigated the schooling systems and the development of technological language and design practice. Project-built pedagogy and practice have shown achievements of which school students are capable, but they do not delineate distinctive gender differences. Knopke (2003) examined models for primary school practice in technological literacy. Although gender differences that emerged from the case studies were highlighted, the issues were not explored in detail.

Little has been written on feminism in technology education in Australian or New Zealand classrooms since the works of Wajcman (1991, 2004). Academia has called for this to become a priority area in order to serve the profession at all levels. Researchers within industry and within tertiary institutions realise there is gender imbalance in STEM courses.

Background

There are three factors which shape how girls learn and function in technology education: biological factor; socialisation; and ecological cognitive approaches that are specific to girls. In the examination of the theoretical issues that have shaped gender participation and engagement in technology education, technology education is defined, in accordance with the Australian national curriculum, as encompassing the practical and creative technologies, including information and communication technologies (Australian Curriculum Assessment and Reporting Authority, 2012).

This paper adopts a social constructionist stance which suggests that knowledge is acquired via the environment and that gender relations are socially constructed. It is argued that, by changing the social and environmental factors from those that reinforce stereotypical behaviours to those which better suit girls, the girls' interactions, engagement and learning will substantially improve in technology education classrooms. By making the environment more female friendly girls’ social and cognitive ability is improved. It is argued that these actions will improve retention and participation rates of female students. Ultimately, these rates influence females’ uptake of tertiary courses in fields such as engineering at universities.

Biological Factor - taking Affirmative Action

Sex is a descriptive category used to designate female and male. Gender is a social category (Rothschild, 1988). Petrina (2007) discusses that differences are not determined by biological sex. There are many examples of high-achieving females worldwide. The issue is differences that are dependent on socio-cultural factors such as bias, overt discrimination, differential treatment, isolation, and socialisation and stereotyping.

Upbringing and socialisation play powerful roles in forming a child’s abilities and confidence: parents, teachers, and the media teach children roles, attitudes and behaviours thought to be appropriate for each sex (Ehrhart & Sandler, 1987; Ford, 2011) In general, boys are encouraged to be active and independent, to explore and to learn how things work. Girls are taught to be passive, verbally oriented, and dependent. Boys receive chemistry sets, building toys, trucks and sports equipment; girls receive dolls, kitchen equipment, and sewing and embroidery kits. Parents’ expectations that their children’s interests and achievements will follow traditional sex roles will steer girls away from certain curriculum areas; in contrast, encouragement from parents for boys to succeed in math, science, and technology is crucial in student decisions to take or not take these courses in high school (Fleer & Jane, 1999, 2004; Petrina, 2007).

Recent research by the author in Australian high school technology education classes has shown that there is a difference between girls who have studied technology for some years and those who are new to the study. Technology teachers, most of whom are male, are positively discriminating for the girls in their classes. Design tasks are applicable to any gender and extra time and tuition is provided to enable any students to meet the challenges that the subject sets them. Two factors work against some of females participating in these courses. First is the family choice stigma or social belief that girls like design rather than hands-on making of things. In recent interviews, some male students suggested that graphics is more suited to girls than technology or engineering studies in high school. The second factor deterring girls is the perception that a long-term career in technology is not an option.

Findings, to date, point towards the psychological research which tells us that differences in socialisation are manifested in neurological and physiological differences between the gender norms. Fuller (2011) suggests that the differences become hardwired over time and, hence, are not easily overcome. Stereotypes are derived from gender norms and sex roles, not from gender itself. Research on brain plasticity highlights that whilst perceptions change over the course of a lifetime, social conditions and experience alter and shape what is part of an individual's perception (Kolb & Whishaw, 1998).

Feminist Critique and the Social Domain

In examining feminist critiques, one must address the social ideologies on which modern technology is based. A brief overview of feminist technology writers illustrates the basis of the social issues that face technology education today.

Feminist critiques emerged in the late 1960s in response to the growing social critique of the directions of science and technology originating on campuses with interdisciplinary courses with social content (Ehrhart & Sandler, 1987; Ford, 2011; Rothschild, 1988). The purpose of feminist scholarship was, first, to develop a body of work about women's lives and ideas and their contribution to society, and, second, to develop a systematic critique of existing scholarship and a distinct feminist theory and approach to knowledge. The 1970s saw the development of this research plus its linking with the curriculum, particularly in the United States. There was a slower and less visible emergence of feminist research and teaching in science and technology fields than in the liberal arts fields. The STS (science, technology and society) programmes became known and linked to technological literacy. Two reasons may explain this. First, there were fewer women in these fields, and, second, not only the culture but the subject matter in these areas had masculine associations. Technology fared a little better than the scientific fields. Studies highlighting feminist issues were published in the early 1980s and brought feminist perspectives to technology in three ways. First, the history of technology uncovered women's contributions to invention and innovation and helped redefine what was seen as significant technology. Second, research examined the relationship of women's traditional work – producing and reproducing – to technological development and change. Finally, it explored and questioned the values and epistemological frameworks that underlie both the study and practice of technology. Feminist critiques have transformed studies of and about women in technology and made some positive changes, notably through the writings of feminists such as Zuga (1999) and Wajcmen (2004) in Australia along with participants who tended to focus on the early years area of learning.

Spender (1985 ed.) in her seminal work, argues that men control language, which works in their favour. Her thesis demonstrated that men have use and control of more positive language, which they use for power. In her 1985 preface, she speaks of the theory of good conduct broken by the suffragettes who have paved the way for some yielding of power.

Stanley's (1998) work on the history of technology cites many authors who talk of the silence of women in the technological developments throughout history. One notes that technical activities related to men are seen as technological and engineered, but those related to women are craft and home-making. Stanley (1992) demonstrates that, historically, in fields of endeavour, the focus from female to male activities has altered. Singh (1997) refers to the discourse related to the production, transmission and acquisition of school computing knowledge based on the Bernstein model (Bernstein, 1981), p. 328). The social structure for this knowledge is seen as a device during that decade which was used as a relay or vehicle for power relations. Computers and digital technologies became the pedagogic device of the struggle and conflict between groups, students, parents and administrators who sought to control the production of the discourses. Bureaucratic agencies, including the school support centres and software production services as well as classified personnel and school experts who would produce, transmit and acquire school computing knowledge, controlled the mechanism.

One aim of the Federal and State Labour Governments during the 1980s in Australia was to link the language of computing to the market place and to produce technologically literate workers for the needs of industry, and this was tied to the social justice platform of gender equity (Australian Govenment). Decades of Australian government policy has looked to redress educational inequality. The Karmel Report of 1973 (Australia Schools in Australia (Karmel Report), May, 1973) saw the establishment of equity committees which still exist in some educational institutions. Following policies then recoiled from it, in favour of programmes such as the Boys' Lighthouse Programs have reclaimed what was perceived as a disadvantage for boys. These did change the face of education but not the underlying social intent of providing assistance for females (Cuttance et al., 2007). Ailwood argued the case for gender equity in Australian education in 2003 via mainstreaming and down streaming issues of gender. Female students still need to be supported in order to participate equally in what have traditionally been male domains. Technology education is an integral learning area where gender inequality can be redressed over time with strong support.

Wacjman (2000), writing on techno feminism, highlighted that at the start of this century the schools in Australia, were at an intersection of feminist studies, techno-science and science, technology and society. The newly emerging info-age of communications lends itself to a bright future for technology that should not hinder people's opportunities on the basis of gender. Wajcman argues that the concept of technology is based on male activities and traditions, and those characterizations continue to define technology by affecting the design and development of artefacts which are tied to social networks. In *Feminism Confronts Technology*, Wajcman (1991) strongly presents the case for developing feminism in social science debates in technology. The differential impact of technological change on women and men focuses on examining the social shaping of technology. Artefacts are shaped by gender relations and have meanings and identity. The exploration of the hierarchy of sexual difference affects the design, development, diffusion and use of technologies. Bijker (1995) had written of the gendered artefacts and the nature of sociological change from a gender perspective. Pinch and Bijker's (1989) work saw technology as a reflection of society and therefore requiring a constructivist approach. Stanley (1993) had developed the notion of gender and functionality within technology. Spender (1982), in analysing the power and control of language as against the artefacts as the key function of Stanley's work, claims that it is this gendered nature of control that is shaping education now.

Blenkley, Clinchy, Goldberger, and Tarule (1986) questioned the power and authority elements of women in society but projected that only certain students will grow beyond their dependence on the existing cultural norms articulated in a male-dominated society. Females perceive truth and knowledge through five perspectives: women's self-concepts; the power of one's mind; knowing; reason; and the institutions women function within – families and schools. These need to be acknowledged in order for them to thrive in self-realization. Females' interest in learning is not necessarily vested in formal education but rather the inner self and the totality of living.

The Blenkley et al. (1986) discussion leads to the question of differences in learning between genders. Hong and associates, in a project-based qualitative research study, concluded that there was little difference apart from time management and a smaller knowledge base for females (Hong, Hwang, Wong, Lin, & Yau, 2011). Danilova and Pudlowski (2010) say that one size does not fit all when it comes to technology and engineering studies. The shrinking pipeline could be due to the use of learning styles that attract some participants and not others. Persson (2010) argues that, in appealing to teens, that issues of gender need to be acknowledged, design and culture exist, and the value that is placed on artefacts with which students wish to work, and to which they relate need to be moulded. The theories related to how girls learn best and how teaching styles may need to be adapted as expressed in the research above leads to an examination of the ecology of learning. The following section examines what factors provide a best fit for technology education and female learners.

Technology and the Cognitive Domain

Feminist critiques have brought a broader perspective to the study of technology education. Weber and Custer (2005) concluded that both genders entered technology education courses with preconceived notions about the types of activities in which they would engage. The challenge for curriculum developers is to make connections between the skills and concepts of some under-rated subject areas and make them more appealing to one or both genders. Weber and Custer recommended that there needs to be more research to better understand the dynamics of student preferences for technology-related topics, activities and pedagogical approaches.

Pedagogical considerations are also critical to sound gender-balanced curriculum design. Research has found that there are instructional methods, learning styles, and interests that can be characterized as distinctively female (Brunner, 1997; Brunner & Bennett, 1997; Zuga, 1999). Group work, shared ideas and collegial development have been shown to cater to the learning styles of girls. The alpha male competition is not inductive to girls participating in technology education classrooms. The opposite is making the difference. Females need to understand the reasons for choices available to them in technology education. They need time to approach what have been unfamiliar concepts, materials and tools in technology-related fields in order to achieve positive high-level outcomes. Unlike their male counterparts, female students will proceed through a task in well managed, measured steps that they are able to design and conquer, in order to present the best possible artefact or outcome. They will use their support networks and the best information available. A recent case study has shown that most boys in the same classes working within the same parameters, with a background in technology, still require a lock-step procedure, unlike their female peers.

Petrina (2007), in discussing teaching methods for the technology classroom, claims that some groups may require differential treatment to have a fair chance to participate and perform. Equal outcomes may require differential treatment; we have to attend to the barriers as well as intervene in the status quo conditions to achieve equity and equality in technology studies.

As recently as 2007, girls in US and Canada were continuing to be relegated to traditionally female programmes, which ultimately impact their earning power and job prospects. The National Women's Law Centre (in 2002 cited in Petrina, 2007) concluded that biased counselling, the provision of incomplete information to students, consequences of career training choices, sexual harassment of girls who enrol in non-traditional classes and other forms of discrimination conspire today to create a system characterised by pervasive sex discrimination (Petrina, 2007). No similar research exists in Australia to use as a comparison.

Biases are hidden and subtle as well as obvious. Sex bias or sexist curriculum materials in technology tend to give girls the message they are not important. The history of technology again portrays inventions and innovations made by men, and in most cases white men. Language that is not consciously gender-specific tends to default to the male in technology courses.

In reviewing gender and career aspirations, McMahon and Carol (2001) suggested that career development programmes should begin at the primary school level. Ford (2011), following on from the work of McMahon and Carol, notes the retreat from feminist discussion which places girls and women at the centre of theory and inquiry in the area. The 1950s witnessed an intensified growth which focussed on vocational aspirations of 'generic' adolescents and adults. Aspects of maturation and parental influence with a minor influence of gender and culture added to expectations of work and, in turn, study requirements. The prevalence of different occupational aspirations according to gender is linked to the stereotypical educational expectations from an extremely early age. Ford's Australian research study in 2011 again showed the gendered view of work stemming from students participating in the early years of education.

Wajcmen (2004) says that, to move forward:

> We need to bridge the common polarization in social theory.… Technology must be understood as part of the social fabric that holds society together; it is never merely technical or social. Rather, technology is always a socio-material product – a seamless web or network combining artefacts, people, organizations, cultural meanings and knowledge. (p. 106)

Ecology and Differentiation in the Classroom

There are pedagogical strategies that can be used to encourage females into technology classes. Schools must investigate factors that entice females to want to be in technology classes and remain there for the completion of their studies. The following section examines prior findings regarding the criteria for effective classrooms and good practice, related to females' preferred learning style. The question here concerns the relevance of these factors in the context of modern technology education.

Rothschild (1988) has noted that the feminist perspective is not about 'adding women and stirring'. In a social setting, if that were the case, essentially the technology education courses would remain the same. That is, courses would be unaltered except for having met a random target for the inclusion of females. There is evidence of this in the past when programmes to increase the enrolments of females have been implemented. The short-term target is met but the long-term results are the same or lower than the starting point (Rothschild, 1988; Tembon, 2008). Therefore, for developing an alternative classroom environment, this study uses the concept of ecology that explores the relationships of organisms to their environments, which include other organisms with whom the reference species has a symbiotic relationship—as in a food chain. Human ecology is the relationships of people to their environments (Hawley, 1986).

"Pedagogical ecology identifies the relationships of instructors and learners in learning environment. Ecologists study these symbiotic interactions to discover insights about the course and parameters of individual organisms' behaviour and development" (Nystrand, Gamoran, & Carbonaro, 1998, p. 4). In education, school systems are analogous to ecosystems whereas reading rituals, response groups, and individual class contexts are more properly ecological niches, distinguished by the reciprocal, mutually dependent roles of their particular members: What one does has implications for what the other can do (Pavlova, 2009).

In environments that focus on learning, the roles are also epistemological, and it is the discourse between participants that defines the operations of the group. Learning is clearly promoted when teachers effectively build on students' prior knowledge and current understanding, for example, by following up on student responses in a constructionist manner. Discourse in these classrooms becomes a more open-ended practice. Discourse becomes one of mutual development in which teachers validate particular student ideas by incorporating them into subsequent questions, in a process of uptake. It is this discourse that promotes greater understanding and encouragement for participants. In essence, it builds trust and empowerment.

Criteria affecting Learning Environments

To analyse activity within classrooms, the ecology of learning environments needs further examination. An ecology is defined by Siemens (2003) as an environment that fosters and supports the creation of communities. A learning ecology is an environment that assists learning. Brown and colleagues (Brown, 2000; Brown, Collins, & Duguid, 1989) define a knowledge ecology as an open system, dynamic and interdependent, diverse, partially self-organizing, adaptive, and fragile. A learning ecology can be characterised by a collection of overlapping communities of interest that cross-pollinate each other; it is constantly evolving, and is largely self–organizing.

In more formal education environments, the concept of self-organization gives way to a more structured process for knowledge transmission. Learning and knowledge is more than static content. It is a dynamic, living, and evolving state. Within a technology education classroom ecology, a knowledge-sharing environment should have seven components (Brunner & Bennett, 1997). First, they are informal, not structured. The system should be flexible enough to allow participants to create according to their needs.

Second, they are tool-rich, with opportunities for users to engage in dialogue and make connections. Third, they have consistency and time for students to engage and create. New communities, projects and ideas start with much hype and promotion, and then slowly fade. To create a knowledge-sharing ecology, participants need to see a consistently evolving environment. The fourth component of a knowledge-sharing environment is trust. Trust is needed to foster a sense comfort. Secure and safe environments are critical for trust to develop.

Simplicity is the fifth element in the ecological environment. Other characteristics need to be balanced with the need for simplicity. Great ideas fail because of complexity. Simple, social approaches work most effectively. The selection of tools and the creation of the community structure should reflect this need for simplicity. Sixth, learning in classrooms is ideally decentralized, fostered, and connected, rather than centralized, managed, and isolated. The seventh and final element is a high tolerance for experimentation and failure. These factors do not relate to females only, the notion should be extended to all students. Given that it is impossible to find a homogenous male characteristic, consideration of these factors will also benefit and attract other learners to this area. Motivation can be championed through pedagogy that suits not just girls but many boys who are themselves not a single homogenous group (Klapwijk & Rommes, 2009).

Recommendations

Educators need to build pedagogical ecologies for technology education, including ecologies that are based on an awareness of the learning styles of female students and provide the skills basis that the social and pedagogical/learning background of females has deprived them of. An awareness of elements which characterise such learning ecologies will lead to classroom dynamics that become self-motivating, self-organising and supportive. Participants learn from one another in supported academic surroundings, peer to peer, and peer to educator. Not only will the success rate and participation of females rise but the ecology will take on a long-term life that is sustained by a passion for learning as much as the social context in which it occurs. Students want to engage.

Conclusion

This paper has argued that research literature highlights three key factors that can assist girls in technology education classes. The first factor is the breaking down of the perception of the trades, and what parents remember of manual arts classes, cooking, sewing, and Shop A and B. These perceptions continue to drive subject choices and, ultimately, career choices for the current generation of youth. The sex divide must be addressed.

Second, modern technology education provides avenues for enhanced female learning in all these spheres of learning including industrial design, construction and we are presently at a critical juncture when the Australian national curriculum is being written and implemented. There is no better time to be commenting and making one's voice heard. Lerman, Odenziel, and Mahun (2003) in summarising their edited work of gender and technology, provided some seminal insights. We should not focus just on females; rather, it is crucial to look at the pairing of femininity with masculinity. Femininity is not the only social boundary used to render technological activity invisible. We need to heed the social ideologies and power and then address why some technologies acquire power status while others remain invisible. Technology as a system has the potential for the distribution of power, but it is the importance of context in understanding technology and the importance of technology in understanding society, that takes us past the old boundaries with which we have been burdened in history in order to pave a new ecology for the new generation of learners.

Finally, an awareness of the feminist critique, issues and values is crucial to assist educators, at all levels, to overcome the stereotyping that still occurs subliminally and in language discourses and, finally, in the enactment. One-off programs to promote STEM and entry into engineering programmes has not proven to be the long-term solution. We, as educators, in order to address the social perceptions that continue to haunt us, need to build notions of technological literacy and technological skills at the earliest ages we can reach children and their families. The UNESCO data (2012) shows that gender is an important issue within Education For All - everywhere.

Affiliations

Vicki Knopke, PhD (Cand.)
Sessional Lecturer, Technology Education,
School of Education and Professional Studies
Griffith University, Brisbane, Australia.
v.knopke@griffith.edu.au

References

Ailwood, J. (2003). A national approach to gender equity policy in Australia: Another ending, another opening? *International Journal of Inclusive Education, 1*(7:1), 19-32. doi:10.1080/13603110210143635

Australia Schools in Australia (Karmel Report). (May, 1973). *Report of the Interim Committee for the Australian Schools Commission*. Canberra, Australia: Australian Government.

Australian Curriculum Assessment and Reporting Authority. (2012). Draft shape of the Australian curriculum: Technologies. Sydney, NSW, Australia: ACARA. Retrieved from http://www.acara.edu.au

Australian Govenment. (2003). *Boys' education lighthouse schools.* Retrieved from http://www.deewr.gov.au/Schooling/BoysEducation/Pages/bels.aspx.

Bernstein, B. (1981). Codes, modalities, and the process of cultural reproduction: A model. *Language in Society, 10*(03), 327-363. doi:10.1017/S0047404500008836

Bijker, W. E. (1995). *Of bicycles, bakelites, and bulbs: Toward a theory of sociotechnical change*. Cambridge, MA: The MIT Press.

Blenkley, M. F., Clinchy, B. M. V., Goldberger, N. R., & Tarule, J. M. (1986). *Women's ways of knowing: The development of self, voice, and mind*. United States: Harper Collins.

Brown, J. S. (2000). Growing up digital: How the web changes work, education, and the ways people learn. *Change: The Magazine of Higher Learning, 32*(2), 11.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Education Researcher, 18*(1), 32-42.

Brunner, C. (1997). Opening technology to girls. *Electonic Learning, 16*(4), 55.

Brunner, C., & Bennett, D. (1997). Technology and gender: Differences in masculine and feminine views. *NASSP Bulletin, 81*(592), 46-51. doi:10.1177/019263659708159208:

Cuttance, P., Imms, W., Godhino, S., Hartnell-Young, E., Thompson, J., McGuinness, K., & Neal, G. (2007). *Boys' education lighthouse schools stage two final report 2006*. Canberra, Australia: Australian Government. Retrieved from http://works.bepress.com/elizabeth_hartnell-young/40/

Danilova, E. A., & Pudlowski, Z. J. (2010). *Public understanding of engineering: Consequences and solutions*. Paper presented at the 1st WIETE Annual Conference on Engineering and Technology Education Pattaya, Thailand. Retrieved from http://www.wiete.com.au/conferences/1st_wiete/5-04-Danilova.pdf

Ehrhart, J. K., & Sandler, B. R. (1987). Looking for more than a few good women in traditionally male fields. *ERIC - Educational Resources Information Centre*, 25.

Fleer, M., & Jane, B. (1999). *Technology for children: Developing your own approach*. Sydney, Australia: Prentice Hall.

Fleer, M., & Jane, B. (2004). *Technology For children: Research -based approaches* (2nd ed.). Australia: Pearson Prentice Hall.

Ford, C. (2011). Gender and career aspirations. *Redress: Journal of the Association Women Educators, 20*(3), 2-7. Retrieved from http://www.publications.awe.asn.au/gender-and-career-aspirations

Foster, W. T. (1996). A research agenda for technology education. *The Technology Teacher, 56*(1), 31-33.

Fox-Turnbull, W. (2010). The role of conversation in technology education. *Design and Technology Education: An International Journal, 15*(1), 24-30.

Fuller, A. (2011). *Valuing boys, valuing girls.* Retrieved from http://www.andrewfuller.com.au/free/ValuingBoysValuingGirls.pdf

Hawley, A. (1986). *Human ecology: A theoretical essay*. Chicago, IL: The University of Chicago Press.

Hong, J.-C., Hwang, M.-Y., Wong, W.-T., Lin, H.-C., & Yau, C.-M. (2011). Gender differences in social cognitive learning at a technolgoical project design. *International Journal of Design Education*, *23*. doi:10.1007/s10798-011-9152-x

King, I. C. (2003). Examining middle school inclusion classrooms through the lens of learner-centered principles. *Theory Into Practice, 42*(2), 151-158. doi:10.1207/s15430421tip4202_9

Klapwijk, R., & Rommes, E. (2009). Career orientation of secondary school students (m/f) in the Netherlands. *International Journal of Technology and Design Education, 19*, 403-418. doi:10.1007/s10798-009-9095-7

Knopke, V. (2003). *Implementing technology education in primary schools in Queensland.* (Unpublished masters thesis). Griffith University, Brisbane, Australia.

Kolb, B., & Whishaw, I. Q. (1998). Brain plasticity and behavior. *Annual Review of Psychology, 49*(1), 43-64. doi:10.1146/annurev.psych.49.1.43

Lerman, N. E, Oldenziel, R., & Mahun, A. (2003). *Gender and technology: A reader*. Baltimore, MD: Johns Hopkins University.

McMahon, M., Carroll, J. (2001). K - 12 Career education programs: From rhetoric to practice. In W. Patten & M. McMahon (Eds.), *Career development programs: Preparation for lifelong decision making.* Melbourne, Vic, Australia: ACER.

Middleton, H. E. (2008). Researching technology education: New Ways of understanding teaching, learning and knowledge. In H. E. Middleton (Ed.), *Researching Technology Education, Methods and Techniques* (pp. 1-5). Rotterdam, The Netherlands: Sense.

Nystrand, M., Gamoran, A., & Carbonaro, W. (1998). Towards an ecology of learning: The case of classroom discourse and its effects on writing in high school English and social studies. New York, NY: National Research Center on English Learning & Achievement University at Albany State University of New York.

Pavlova, M. (2009). Conceptualisation of technology education within the paradigm of sustainable development. *International Journal of Technology and Design Education,, 19*, 109-132. doi:10.1007/s10798-008-9073-5

Persson, I. H. (2010). Do artefacts reflect our thinking about gender? In H. Middleton (Ed.), *Knowledge in technology education* (Vol. 1, pp. 178- 185). Brisbane, Qld, Australia: Griffith Institute for Educational Research.

Petrina, S. (2007). *Advanced teaching methods for the technology classroom*. Hershey, PA: Idea Group.

Pinch, T. J., & Bijker, W., E., (1989). The social construction of facts and artifacts: Or how the sociology of science and the sociology of technology might benefit each other. In T. P. H. Wiebe, E. Bijker, & T. J. Pinch, (Eds.), *The social construction of technological systems: New directions in the sociology and history of technology.* (pp. 17 - 50). Cambridge, MA: MIT Press.

Rothschild, J. (1988). *Teaching technology from a feminist perspective: A Practical guide*. New York, NY: Pargamon.

Siemens, G. (2003). Learning ecology, communities and networks: Extending the classroom. Retrieved from Learning Ecology, Communities and Networks ou.ni website

Singh, P. (1997). From Software design to classroom practice: An Australian case study of the gendered production, distribution and acquisition of computing knowledge In C. Marshall (Ed.), *Feminist critical policy analysis: A perspective from primary and secondary schooling* (pp. 109 - 133). New York, NY: Farmer.

Spender, D. (1982). *Invisible women : The schooling scandal*. London, England: Writers and Readers.

Spender, D.(Ed.). (1985). *Man made language*. London, England: Routledge & Kegan Paul.

Stanley, A. (1992). Once and future power: Women as inventors. *Women's Studies International Forum, 15*(2), 193-203. doi:10.1016/0277-5395(92)90100-A

Stanley, A. (1993). Mothers and daughters of invention: Notes for a revised history of technology. In P.D. Hopkins (Ed.), *Sex/Machine*. Bloomington, IN: Indiana University.

Stanley, A. (1998). Women hold up two-thirds of the sky: Notes for a revised history of technology. In P.D. Hopkins (Ed.), *Sex/Machine* (pp. 17-32). Bloomington, IN: Indiana University.

Tembon, M. (2008). Overview. In M. Tembon & L. Fort (Eds.), *Girl's education in the 21st century: Gender equality , empowerment and economic growth* (pp. 3-21). Washington, DC: The World Bank.

UNESCO. (2012). Better life, better future:One year on. Retrieved from http://www.unesco.org/new/en/unesco/events/education-events/?tx_browser_pi1[showUid]=6361&cHash=5d4425a566

Wajcman, J. (1991). *Feminism confronts technology*. University Park, PA: The Pennsylvania State University.

Wajcman, J. (2000). Reflections on gender and technology studies: In what state is the art? *Social Studies of Science 2000, 30*(447). doi:10.1177/030631200030003005

Wajcman, J. (2004). *TechnoFeminism*. Cambridge, England: Polity Press.

Weber, K., & Custer, G. (2005). Gender-based preferences toward technology education: Content, activities, and instructional methods. *Journal of Technology Education, 16*(2), 55-69.

Williams, P. J. (2011). Research in technology education: Looking back to move forward. *International Journal of Design Education, 7*(7 May), 1-9. doi:10.1007/s10798-011-9170-8

Zuga, K. F. (1999). Addressing women's ways of knowing to improve technology education environment for all students. *Journal of Technology Education, 10*(2), 1- 11.