Factors that encourage and facilitate female students to participate and engage in Technology Education

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<td>Australian Bureau of Statistics</td>
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<tr>
<td>ACARA</td>
<td>Australian Curriculum Assessment and Reporting Authority</td>
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<tr>
<td>EA</td>
<td>Engineers Australia</td>
</tr>
<tr>
<td>HOD</td>
<td>Head of Department</td>
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<td>INTAD</td>
<td>Industrial Technology and Design Teacher’s Association of Queensland</td>
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<td>ITD</td>
<td>Industrial Technology and Design</td>
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<tr>
<td>ITEA</td>
<td>International Technology Educators Association</td>
</tr>
<tr>
<td>ITTEA</td>
<td>International Technology Teachers Education Association</td>
</tr>
<tr>
<td>MCEETYA</td>
<td>Ministerial Council Education Employment, Training and Youth Affairs</td>
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<td>MIT</td>
<td>Melbourne Institute of Technology</td>
</tr>
<tr>
<td>NCVER</td>
<td>National Centre for Vocational Education Research</td>
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<tr>
<td>OP</td>
<td>Overall Position</td>
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<tr>
<td>ORACLE</td>
<td>Observational research and classroom learning evaluation</td>
</tr>
<tr>
<td>PATT</td>
<td>Pupil’s Attitudes Towards Technology</td>
</tr>
<tr>
<td>QCAA</td>
<td>Queensland Curriculum and Assessment Authority</td>
</tr>
<tr>
<td>QSA</td>
<td>Queensland Studies Authority now known as QCAA</td>
</tr>
<tr>
<td>QUT</td>
<td>Qld University of Technology</td>
</tr>
<tr>
<td>SCOT</td>
<td>Social Construction of Technology</td>
</tr>
<tr>
<td>STEM</td>
<td>Science, Technology, Engineering and Mathematics</td>
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<tr>
<td>TfAA</td>
<td>Technology for All Americans project</td>
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<tr>
<td>UNESCO</td>
<td>United National Educational, Scientific and Cultural Organisation</td>
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<tr>
<td>UQ</td>
<td>University of Queensland</td>
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Declaration

This work has not been previously submitted in any University. To the best of my knowledge and belief, the dissertation contains no material previously published or written by another person except where due reference is made in the dissertation itself.

Signed: ……………………………………………………..

Student name: Vicki Margaret Knopke
Date 25 May 2015
I dedicate this thesis to my family. Without their support I could not have had the time and space to research and write. To Greg Knopke and Guy Knopke my gratitude is forever. For not letting me give up on this quest so close to the end when the world was changing for me. Your love and support enabled me to complete the thesis.

If I Had My Life to Live Over  By Nadine Stair
I'd dare to make more mistakes next time.
I'd relax. I would limber up.
I would be sillier than I have been this trip.
I would take fewer things seriously.
I would take more chances.
I would take more trips.
I would climb more mountains and swim more rivers.
I would eat more ice cream and less beans.

I would perhaps have more actual troubles but I'd have fewer imaginary ones.

You see, I'm one of those people who live sensibly and sanely hour after hour, day after day.

Oh, I've had my moments and if I had it to do over again, I'd have more of them. In fact, I'd try to have nothing else. Just moments.

One after another, instead of living so many years ahead of each day...

If I had my life to live over, I would start barefoot earlier in the spring and stay that way later in the fall.

If I had it to do again, I would travel lighter next time.
I would go to more dances.
I would ride more merry-go-rounds.
I would pick more daisies.

Gender and values have been the two things close to my heart as an educator. To know that female students need to be empowered has always been important to me as a teacher. Teaching youth about values that empower them to engage with life around them is fundamental.

Technology Education stemmed from my personal background of helping my father build boats, weld and restore beautiful timber furniture. My love of design and aesthetics has always been with me as an artist and as a teacher seeking new and innovative ways to function in a system which needs to cater and encompass the needs of modern day youth. Teachers need to embrace all technologies and make them an effective part of what they do in a highly connected world.
I hope I have been able to instil some of these concepts into the trainee teachers I have lectured and tutored and the many youth I have taught and mentored.
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Such a study was not possible without the support of INTAD (Design and Technology Teacher’s Association of Qld) and the teachers who made their classes available to me to undertake the research.

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Abstract

Females are significantly under-represented in Technology Education classrooms in senior secondary schools. Participation rates for female students in Science, Technology, Mathematics and Engineering (STEM) subjects are lower than those of males. Data show that this has a flow on effect on females entering subjects such as Engineering at the tertiary education level. Specifically, Williams (2011) argues that gender issues in Technology Education have been under researched on a world scale, but particularly is under researched in the Australian context. Consequently, this thesis aimed to identify positive influences that encourage female student participation in Technology Education.

The topic was examined through three research questions with appropriate research methodologies designed to provide insights into those questions. The first research question asked – what factors have influenced female student’s choices to take Technology Education classes as part of their senior school pathway? The investigation was undertaken through an examination of the social construction of realities from the individual and the collective group point of view (Bijker, Hughes, Pinch, & Douglas, 2012), drawing on theories of women’s ways of knowing by Belenky, Clinchy, Goldberger and Tarule (1986).

The second research question asked - how teaching and learning was conducted and approached in selected Technology Education classrooms? The study investigated Year 11 female students in three secondary schools. In doing so, the ecology of the learning environment, the context of the learning and social interactions were analysed and triangulated from the staff, student, and administrators perspectives.

The third research question asked - what values were addressed in the teaching and learning in specific contexts in Technology Education classrooms? This aspect examined the multifaceted interpretation of values and analysed the engagement of youth and the teaching staff with the concept of values.

The research study examined three senior secondary schools in South-east Queensland. The researcher took on the role of participant observer visiting the schools over a fourteen week period.

The qualitative, feminist ethnographic case study methodology which was conducted allowed for the examination of behaviour, beliefs, language and how shared patterns of interacting in the educational settings developed over time, in the research. The methodology was guided by socio-cultural framework that encompassed a feminist construction of technology. Feminist critiques in Technology by Wajcman (2004) and Spender (1980) shaped the analysis which described, analysed and interpreted the patterns of behaviour through four data sets. These were: interviews; observation data; audio recordings and photographs.
Abstract

The research was conducted using seven themes. Five themes: the ecology of learning; gender and Technology Education; language use in classrooms; socio-cultural approaches toward learning; and values were drawn from a synthesis of the literature. Two emerged from the case study investigations. They were: motivation; and role modelling and peer support. The outcome identified seven factors that have influenced females’ choices concerning Technology Education at the senior secondary level.

The seven key findings drawn from common findings in the case studies of the study were that:

1. Learning within a techno-social sphere where there are positive social interactions may be the best environment for females. Providing a structure which the female learners could be guided by, was found to enable these students to become self-directed learners, gaining confidence to engage in the Technology process, realise a design and transform it into an artefact.

2. There is the need to teach higher order thinking concepts and project management skills to all students. Female students excelled in these areas and there is the potential to attract more female participants over time if factors such as thinking skills and physical skills development are taught as enablers which allow female students to function confidently in workshop settings.

3. There is no such concept as gender neutral curriculum. Language use is important and the control of language and terminology continues to drive the learning. At times, the female students lacked a voice because of the technical terms and skills inherent in the subject.

4. A pedagogy that addressed and supported female learners would in turn motivate them to choose and engage in Technology Education. Scaffolding with problem solving, in a structured learning environment encouraged female learners to excel.

5. It is important to have role models and a peer group within the environment. Role models need not be same sex but were pivotal in the early development of female learners in technology. The presence of female teachers for Technology provided positive agency for the female students. This is consistent with Siemens (2003) argument that learning environments mixed with positive gender messages in Technology Education will promote female participation. Brown, Collins and Duguid (1989) argue it is diversity which encourages female learners to self-organise as a characteristic of their learning style that promotes learning communities.

6. Students can overcome the historic stereotypes if they are motivated to achieve in the subject area. The types of projects undertaken in the curriculum are important. Meaningful real world tasks have an impact on female students.
7. There was a lack of awareness of the concept of values or goals at a personal, local and global level. This appeared to remove a potential source of knowledge which female students may relate to as well as being a motivational factor for Technology Education. Thus, this thesis reports that the impact of curriculum on Technology students has an influence on what female students choose to study. Furthermore, life experiences and vocational aspirations of students contribute to female students’ study plans. Having knowledge of the benefits of the subject area, the development of thinking and hands on skills and the advantages which the learning may afford participants appears to make a positive difference to females.

A female oriented pedagogy that meets mixed learning styles with structure that provides individuals with the independence to problem solve and discuss issues appears to be an undervalued aspect of Technology Education. The worth of the output and its social value is part of the criteria that female students use to judge the relevance of Technology Education courses. Broadening the information base about Technology Education will expand its appeal to potential female participants. This is an area for further study.

Gender support and role modelling is the factor which appeared to afford a sense of well-being to female students and provided some security of place when the female students commenced study in Technology classes. Increasing female participation would appear to involve a combination of values orientations, curriculum content, pedagogy and cognitive challenges in a safe and supportive environment. The importance of relationships and acknowledging difference was the key to the plurality of the approach that could increase female participation in Technology Education.

This topic contributes to our knowledge of Technology Education learning at the senior secondary school level. Specifically, it contributes to our understanding of the factors that engage female students.
Chapter 1
Introduction

The aim of this study is to examine the factors that encourage and facilitate female students to participate and engage in Technology Education classrooms and, as a consequence, increase participation rates in the long term.

The topic was examined through three research questions. The first research question asked – what factors have influenced female student’s choices to take Technology Education classes as part of their senior school pathway? The investigation was undertaken through an examination of the social construction of realities from the individual and the collective group point of view (Bijker, Hughes, Pinch & Douglas 2012), drawing on theories of women’s ways of knowing by Belenky, Clinchy, Goldberger and Tarule (1986).

The second research question asked - how teaching and learning was conducted and approached in selected Technology Education classrooms? The study investigated Year 11 female students in three secondary schools. In doing so, the ecology of the learning environment, the context of the learning and social interactions were analysed and triangulated from the staff, student, and administrators perspectives.

The third research question asked - what values were addressed in the teaching and learning in specific contexts in Technology Education for classes? This aspect examined the multifaceted interpretation of values and analysed the engagement of youth and the teaching staff with the concept of values.

This study examines the proposition that an active and positive social construction of gender will improve the quality of Technology Education with respect to gender engagement in Technology Education. It does this with respect to Australian national developments in Technology Education and is timely due to the writing of the National Curriculum Technologies (ACARA, 2014).

Gender issues in Technology Education have been under researched (Williams, 2011). The focus of this paper is to explore the way gender is constructed in relation to Technology Education classrooms and relate this to the current context of Australian society. Considerable time has been devoted by UNESCO (2011) to the encouragement of females to participate, not only in education generally, but specifically in Technology Education and more recently in information technologies.
1.1 Technology in context

Technology is more than a social force in society. Throughout history, people have created and used technology to better their lives or to meet their many needs. Scholars point to the fact that in the history of humanity, the use of technology has become a defining characteristic of human survival. The technology used by society determines the nature and patterns of work. It influences leisure time and entertainment, shapes the organisation of business and industry and alters basic beliefs about what is valued at both a personal and social level. Despite our dependence on technology few people understand how it is developed, integrated into society or assessed (Gilberti, 1999).

Gilberti (1999) argues that Technology educators must convince the education community of the importance of Technology and that student’s as part of their general educational experience should become knowledgeable about the power and limitations of technology. Students need to recognise that the development of knowledge is directly influenced by technology. As technologists help to meet human needs and wants with inventions and innovation they contribute to an ever-growing knowledge base. Finally, Gilberti (1999) argues that strong leadership is needed to fill places in post-secondary education for career paths.

1.2 Context of the study - Background to Technology Education in Australia

One of the key contextual factors that inform the development of this study is the development of a national curriculum across Australia. Historically, and importantly, there have been a number of attempts to establish a national curriculum in Technology Education for Australia.

The Mayer Committee in 1992 along with the National Ministers for Education in Australia set the agenda for the emergence of a National Curriculum for Australia. Technology was to be linked to vocational education (Mayer, 1992). The national curriculum (Australian Education Council & Curriculum Corporation, 1994) as an outcome of the Hobart Declaration did not succeed in binding the states of Australia with one set of common documents. The emergence of the Draft Shape of the Australian Curriculum: Technologies (2012) and the subsequent Technologies Curriculum in 2014, as part of the Australian National Curriculum, provided a timely incentive to examine developments in this field of learning. The following provides a brief overview of the Australian context. The Draft Shape of the Australian Curriculum: Technologies (ACARA. Australian Curriculum Assessment and Reporting Authority, 2011, 2012) identified its development as stemming from the Melbourne Declaration
on Educational Goals for Young Australians in 2008 (MCEETYA, 2008). The Technologies Education learning area was designed to focus on:

The purposeful use of technologies knowledge, understanding, and skills including the creative processes that assist people to select and utilize materials, information, systems, tools and equipment to design and realize solutions (Ministerial Council on Education Training and Youth Affairs, (Barr et al., 2008, p. 1).

The inclusion of Technology within the Melbourne Declaration recognises that the future of the learning area does have a place in the Australian context. The identity of the subject areas within Technology and the ownership by individual teachers and practitioners in the Australian context are however, at times questioned (Barlow, 2010).

The first goal of the Melbourne Declaration on Educational Goals for Young People “is that all Australian youth are provided access to high quality schooling free from discrimination based on gender, language or sexual orientations”(Barr et al., 2008, p. 7). The basis for the new national curriculum was that young Australians will become active and informed citizens committed to the national values of democracy, equity, justice and personal values (Barr et al., 2008).

The National Centre for Vocational Education Research (NCVER) 2011 paper on Vocational Education in Australia recognized the importance of training trends within the nation and argued for government intervention in training areas on economic and equity grounds (Pocock, Skinner, McMahon, & Pritchard, 2011).

The study that forms part of this thesis is located within the senior secondary schooling years, which refers to Years 11 & 12 in Australia and normally relates to students who are approximately 16-18 years old. The rationale for locating the study in this sector of schooling was the government initiative of providing post school pathways. This determined that students over the age of 16 must be working full time or taking up vocational training or tertiary studies. Students taking up Technology Education should be equipping themselves to be better placed in a practical role for further employment or training. The government’s view was that there was not only an educational benefit for students to engage in this learning area but also an economic benefit for themselves and industry. Dakers (2007) argues that this contributes to the economic rationalist argument that training in this area will contribute workers for industry rather than for Technology as an end in itself.

Burrowes, (2007) argues that as Australia moves further into the knowledge-based economy, it is vital for Australia’s future development that the number of engineering graduates increases. To increase the number of engineers, students must develop an interest in Science, Technology, Engineering, and Mathematics (STEM) throughout their school life.
Burrowes, on behalf of Engineering Australia (2007), in line with world bodies such as UNESCO identified the need for more women in the Science, Technology, Engineering and Mathematics professions. The under representation of women in these fields was evident from as early as 1985 when Byrne investigated the causes and identified possible remedial action for the under-representation of females in engineering (Byrne, 1985). The American Association of University Women (2002), The Girl Scout Association of America Research Institute (Sadler, Sonnert, Hazari, & Tai, 2012) and Technology researchers such as Weber and Custer (2005) acknowledge the under representation of women in Technology Education via STEM investigations, but little has been achieved in terms of recent studies identifying changed participation rates by females.

Technology, as defined by the Technology for all Americans project (TfAA) (International Technology Educators Association (ITEA), 1996), is the innovation, change, or modification of the natural environment to satisfy perceived human needs and wants (International Technology Educators Association (ITEA), 1996). The definition is taken in the broadest possible sense to encompass all subjects that have been afforded a similar design process in the past in Australia. Subjects which have been included comprise; agriculture, industrial arts and design, graphics, home economics, business studies, engineering studies, and information and communication technologies.

This research focuses on Australian developments in the global context of Technology Education and reviews research in the field with a particular focus on design and engineering Technology based in industrial arts. It draws on earlier research concerned with technological literacy which encompasses gender issues (Dow, 2006; Dugger Jr, 1995; Knopke, 2002). Interest in this study grew from a personal interest in gender and the empowerment of youth. Working as a senior secondary teacher for sixteen years with Education Queensland (EQ) and Queensland Studies Authority (QSA) in the role of Technology project officer provided a unique vantage point to visit schools and see how few females were studying in the design and technology areas of Technology Education. Moving to the role of Principal Education Officer, School Improvement, in a metropolitan region of 104 schools, I was again able to visit schools and note where the female students were absent from particular areas of learning.

This timing for the research study emerged through the development of the national curriculum in Australia during 2011 to 2012 and the commencement of the writing of the new syllabus for Technologies Education. The process of consultation and the stepped release of the Australian National Curriculum documents have provided lead time for writing teams to consult with practitioners in order to incorporate best practice into the newly shaped curriculum framework documents that will collectively form the Australian curriculum. The research reported here parallels the progress that is being made in the area of Technology Education in Australia as a function of developments in the Australian National Curriculum development in
Technologies, which is comprised of the two learning areas of Design and Technology and Digital Technologies.

On 8 December 2010, all education ministers endorsed Australia’s first national curriculum - Foundation to Year 10 in the first four learning areas of English, Mathematics, Science and History. Phased implementation of the curriculum saw the learning areas of Geography, Languages and the Arts while Phase 3 was Health and Physical education, Technologies, Economics and business, Civics and citizenship development (Australian Government, 2012, p. 4).

The Queensland Government’s Smart Qld: Smart State Strategy 2005 – 2015 highlighted the need to elevate the importance of skills and innovation across all fields of enterprise (Department of Employment and Training, 2005, p. 5). Technology diffusion and connectivity were key elements of this strategy. This development along with education initiatives at the time saw the establishment of the Smart Learning Academies of learning specialising in areas that would contribute to the outcomes of this political agenda (Department of Education & Training, 2007). The two aims of this strategy were to encourage high levels of scientific, technological and mathematical literacy for all Queenslanders while building a workforce with the high-level STEM skills required to remain competitive in a knowledge-based economy (Department of Employment and Training, 2005).

The first National Action Plan for the Education of Girls (1993 – 1997) was published in 1993, (Australian Education Council, 1993a) and Education Queensland followed other states in establishing a Gender Equity unit with the aim of developing gender equity policy. Subsequently, new priorities emerged which emphasised the social construction of gender from the early years through schooling, and there was an expectation that there would be an alignment of syllabus and pedagogy (Yates, 1997). There were calls for action plans, gender mainstreaming, equity issues discussions, equity co-ordinators and committees established along with research grants to associations such as the Association of Women Educators for publications like Gender up Front (Nayler, 1997). This movement did not sustain itself with the publication of Boys: Getting it Right report (House of Representatives Standing Committee on Education and Training, 2002) overshadowing any progress that had been made for females in Australian education.

The contribution of this thesis is to explore how gender and values through an awareness of the underlying concepts within a pedagogical framework can be applied to increase classroom participation of females. It is these concepts and interactions in Technology Education that will ultimately heighten the participation of women in areas related to the Technology profession.
In reviewing research around policy and curriculum practices related to gender and Technology Education the private (Catholic and Independent) and public schools are considered equal. Specific attention is given to new developments and current practices in these educational settings with respect to the construct of gender in Technology Education and the impact which values have on the changing curriculum. Current programs and pedagogy in senior secondary school Technology Education subjects is the object of the research activity. Findings from the research aim to elicit a model of good practice through an analysis of data, the review of literature and results of the research study. This research builds on a previous research thesis (Knopke, 2003) which examined technological literacy with aspects of gender, national principles of Active and Informed Citizenship and the notion of literacy overlaid onto a model of technological literacy for Queensland primary schools. Other research (Blenkley, Clinchy, Goldberger, & Tarule, 1986) shows that the values of schooling and those values adhered to by females can align. The research reported here should also have practical significance as it should assist national curriculum implementation in Australia. Given that many females are underrepresented and disconnected from technological learning, strategies which promote effective classroom environments should enhance the status of Technology Education.

The Technology for All Americans Project (TfAA) aimed to have every citizen become technologically literate. The term ‘technological literacy’ refers to one's ability to use, manage, evaluate, and understand Technology (International Technology and Engineering Educators Association (ITEEA), 2012). In order to be a technologically literate citizen, a person should understand what Technology is, how it works, how it shapes society and in turn how society shapes it. Moreover, a technologically literate person has some abilities to ‘do’ Technology that enables them to use their inventiveness to design and build things and to solve practical problems that are technological in nature. A characteristic of a technologically literate person is that they are comfortable with and objective about the use of Technology neither scared of it nor infatuated with it. Technological literacy is much more than knowledge about computers and their application. It involves a vision where every person has a degree of knowledge about the nature, behaviour, power and consequences of many aspects of Technology from a real world perspective.

The current research such as the Australian Chief Scientist’s Report (2012) shows that there are gaps in social structures of knowledge related subjects which could better position females in Technology. Public research funds have been provided to the STEM movement in many countries. These include the United Kingdom, America and Australia. In Australia, priority at a national level has been afforded to mathematics and science while only lip service has been paid to Technology and Engineering (Report of Chief Scientist, 2012). At a political level, it has been targeted through Science Teachers and Associations training teachers for implementation in schools. Knight and Cunningham (2004, p. 4) conclude that “Engineering
and Technology are inextricably linked and that a positive or negative perception of one would lead to a negative career choice in both areas”.

Having explored the general contextual issues for the study, the following section examines issues of gender to provide the more specific context for the thesis.

1.3 Issues of Gender and Values

Issues associated with gender parity have different dimensions and are present at different levels. Globally, some 39 million girls of lower secondary age are currently not enrolled in either primary or secondary education, while two thirds of the world's 796 million illiterate adults are women. Only about one third of countries have achieved gender parity at secondary level (UNESCO, 2012a). The global political push to reach equity targets in education is strong. The UNESCO education initiative to mark the milestone of the global and political agenda aims to improve on Girls’ and Women’s Education for Empowerment and Gender Equality (UNESCO, 2012a).

UNESCO Courier editorial by Bokova (2011) reports that there has been progress in advancements in gender parity with primary school enrolments, especially in countries that featured the greatest gaps. It is at the secondary level the disparities have increased (Bokova, 2011). Women are making breakthroughs in higher education in all regions, however they still account for only 29 percent of researchers. The 2012 Education for All Global Monitoring Report shows that the share of illiterate women has not changed over the last 20 years (UNESCO, 2012).

Australian figures in The Education for All Global monitoring report (UNESCO, 2012) shows there is gross enrolment ratio of students in secondary school at 89.7% (2000) of which 91% were females. Therefore, although females’ enrolment at school is not an issue in Australia, some ‘streaming’ issues are. Figures from selected Queensland secondary schools offering Technology Education show that, in 18 secondary schools, there was fewer than 20% of females enrolled in Technology classes (Queensland Studies Authority, 2012).

Engineers Australia (EA)(2012) argue that as Australia moves further into the knowledge-based economy, it is vital for Australia’s future development that the number of engineering graduates increases. To increase the number of engineers, children must develop an interest in STEM throughout their school life.

The EA discussion paper (Burrowes, 2007) concludes that, while Australia has been a world leader in research examining the challenges facing women in Engineering during the 1990’s, any gains made are currently going backwards and contributing to the current skills shortage. Female member numbers in the Engineering Institute itself in 1980 were 9%, in 1990
these had risen to 13.30%, in 2000 11.8 % and in 2005 17.5% of the total (Burrowes, 2007, p. 3).

Gender participation in the Australian labour force in August 2011 was 59%, which was double that of August 1961 of the report Fifty years of the labour force: Now and Then (Australian Bureau of Statistics, 2011) illustrates ages and times in a family cycle where women do participate most in the workforce. The link between training for a labour force (Technology Education), and participation in specific sectors which contribute to the local and national economy and economic development was acknowledged at the individual and national levels when Technology curriculum was first introduced world-wide in the seventies.

Thus, the long term effects of having greater female participation in Technology Education classrooms are argued to be important for two main reasons. Firstly, it is to provide greater long term access to the workforce in terms of practical skills and trade areas for females (the vocational aspect of education for secondary and tertiary pathways). Secondly, it is to empower more females to enter university courses in engineering and STEM related areas. Considerable funds have been put into enticing female secondary science females into these areas, however, the retention rates are extremely low and the drop out syndrome known as the ‘fading pipeline’ is high. A positive experience toward Technology Education at an early level of schooling within our education system could alleviate what is increasingly becoming a national dilemma.

Therefore, when females are not engaged in Technology Education learning they are missing out on potential future careers and career paths that could afford them openings to not only higher education facilities but better paid, and skilled jobs using technical knowledge. This study aims to contribute to our understanding on how to engage females.

Issues of gender in Technology Education have been under-researched, and the studies that are available mainly focus on such issues as the types of learning activities, topics, and instructional methods in Technology Education (Weber & Custer, 2005).

The literature review presented in Chapter 2 identifies the gaps in our knowledge related to how female engagement can be effectively applied in classrooms. The case studies in this thesis examine some of these areas within the Australian context while focusing on the role of values in females’ engagement in Technology Education.

The importance of values for teaching and learning have been acknowledged by government reports (Hill, Corbett, & Rose, 2010) and other research, however, values research in Technology Education is limited and the studies that are available were focused on values in general (Pavlova, 2009b). This study will examine the feminist thinking relevant to Technology and the way it may influence females’ participation in Technology Education classrooms.

Therefore, the aim of this research is an examination of factors that encourage and facilitate female student’s to participate and engage in Technology Education. Are there factors
which underpin the development of effective classroom environments that meaningfully engage females in Technology Education and, therefore, increase female participation rates?

This research is a qualitative study where data were collected through observations and interviews with students, teachers and administrators. The methodology was guided by socio-cultural framework that includes the feminist construction of technology. Feminist critiques have been undertaken in Technology by Wajcman (2004) and Spender (1980) and these seminal works shape the critique. Successful classrooms and practices which attract female students as Technology Education learners will be the subject of the study. The particular interest area is classrooms that effectively engage female students in Technology Education, the learning and the pedagogy within this domain (Weber & Custer, 2005).

The impact of curriculum on students, whether it is the intended or unintended curriculum and student backgrounds in terms of socio-economic experiences and exposure to areas of the curriculum do have an influence on what students choose to study within school settings. Life experiences and vocational aspirations of students will further contribute to shape what courses students opt to study in senior high school. This is the contextual area of this study as it is the choice of courses which may provide entry to institutions of higher education and training after high school.

1.4 Contribution to knowledge about Technology Education

The thesis makes a contribution to knowledge in terms of issues concerned with females and Technology Education. The thesis contributes to knowledge about learning in Technology Education and effective classroom environments that are gender inclusive in Australian schools. It does this by examining the processes that meaningfully engage female students in Technology Education classes.

The thesis also contributes to knowledge in terms of female Technology Education students and values. It does this through an examination of global issues such as recyclability and values short or long term personal beliefs that have come to the forefront of concern within the teaching, and researching of Technology and Technology Education. This research highlights the need for exposure to the concepts of values and sustainability. This outline provides a broad agenda for curriculum planning as along with teaching units that carry local meanings found in school settings. Both contexts are needed to encourage female participants.

In what is an increasingly globalised world Technology Education has much to offer. In examining national Technology Education it is engagement with values that has expanded the field into the global arena and yet gender participation rates remain imbalanced (Pavlova & Turner, 2007). Given the minimal level of education uptake, the question must be asked as to
what is the ideal level of engagement in technology and connected technologies, such as digital platforms, for females. Figures from selected Queensland secondary schools offering Technology Education subjects show that in 18 secondary schools there were fewer than 20% of female students enrolled in specific Technology classes.

The following sections define key terms used throughout the thesis.

1.5 Definitions:

1.5.1 Socio-cultural
Socio-cultural educational research and practice explores the zone of proximal development (Vygotsky, 1978). This theory provides instruction which recognizes and empowers linguistically and culturally diverse students. Socio-cultural theory describes learning as distributed, interactive, contextual, and the result of a learner’s participation in a community of practice. The collaboration of thinking that results from these processes opens up access to direct data on thought processes and provides avenues to uncover distinguishing characteristics and recognize the interdependence of concepts. The goal in using a socio-cultural methodological approach is to establish a process and provide ways of documenting change and transformation.

Consideration is given to the socio- constructivist and social constructionist theories. Some discussion will be given to the concept of the Social Construction of Technology (SCOT) as written by Bijker, Hughes and Pinch (1987). The framework provides a vehicle for the exploration of social constructionism as a critically and politically engaged set of views on knowledge and science which provides a more applied model than does the constructivist approach with its broader set of views on the nature of knowledge and cognition. (Henriksen, Dillon, & Pellegrini, 2015; Smith, 2006). Social constructionism stemmed from the Vygotskian notion of activity theory as a social phenomenon.

Underpinning constructionism is motivation – students are more motivated to learn if they are to produce an artefact that others can see i.e. for an audience (Lerman, Oldenziel, & Mahun, 2003). It is a social concept or practice that is the construct (artefact) of a particular group. This social construction of reality which stems from humans as social beings is an ongoing and dynamic process, Social constructs are not those given by nature but ones that must be constantly maintained and re-affirmed in order for them to persist.

Hacking (1999) in questioning ‘The Social construction of what?’ notes the constructionist notion that social values play a role in context of discovery in learning. In the context of how one justifies claims it is not the factual evidence that does the justifying but the background social values. Beliefs and social values are intertwined. A social notion cannot be
brought in to fill a rationalist gap but rather he claims that rationality itself is constitutively social.

1.5.2 Defining the Learning Area of Technology (ACARA)

The Australian Curriculum Assessment and Reporting Authority (ACARA) in February 2014 released the Technologies syllabus for Australia requiring that students engage in technological capabilities and with technological and computational thinking (ACARA, 2014). The Australian text used is less of a definition, but rather a concept which is not centred on objects but focussed on capabilities those students will achieve. It is designed to shape learning from Pre-school onwards. Senior school Technology courses ideally link to this concept but define their own specific content areas for example, Engineering Studies (Queensland Studies Authority, 2012).

The Technologies learning area focuses on the purposeful use of technologies knowledge, understanding, and skills including the creative processes that assist people to select and utilise materials, information, systems, tools and equipment to design and realise solutions. These technologies solutions address “personal, community and global needs and opportunities that improve quality of life while taking into account societal values and economic, environmental and social sustainability” (ACARA, 2014, p. 1).

Design and technologies will have students learning to develop and apply technologies knowledge, processes and production skills to design, produce and evaluate solutions using traditional, contemporary and emerging technologies for real-world needs, opportunities, end-users, clients or consumers in a range of technologies contexts.

Digital technologies will have students learning to develop and apply technical knowledge, processes and computational thinking skills, including algorithmic logic and abstraction, to transform data into information solutions for real-world needs, opportunities, end-users, clients or consumers in a range of technologies contexts (ACARA, 2014).

1.5.3 International definitions

Technology has been defined as the innovation, change or modification of the natural environment to satisfy preconceived human needs and wants (International Technology Educators Association (ITEA), 1996, 2006).

Technology Education encompasses all subjects that have design processes as the key learning activity. Petrina (2007) outlines the many aspects of Technology Education. Some are applicable to the Australian context and will be drawn upon in the study. In the Australian context subjects such as Agriculture, Business studies, Industrial arts and design, Graphics, Home economics, Hospitality, Information and Communication Studies, Technology Studies, Engineering Studies, fall into this definition. Whilst there is currently much debate surrounding the term it links to past and present syllabus practice in the Australian education system.
1.5.3.1 Gender and empowerment

Gender in previous years has been defined as ‘identity’ (Eckert & McConnell-Ginet, 2003, p. 4). Eckert and McConnell-Ginet argue that the interpretation has moved from something one has, to viewing gender as involving what people ‘do’. In this case gender does not just exist but is constantly in a state of change through being reproduced and acted out as an identity.

Empowerment can be defined as how individuals and communities engage in learning processes in which they create, appropriate and share knowledge, tools and techniques in order to change and improve the quality of their own lives and societies. Through empowerment, individuals not only manage and adapt to change but also contribute to generate changes in their lives and environments (Wajcman, 1991).

1.5.4 Feminist theories

In post-modern theory gender itself is a social construct. Post-modernist feminism has tried to understand and clarify how gender inequality interacts with other issues such as racism, homophobia, classism and colonization to produce and establish a matrix of domination. The highly individual oriented post-modern feminist thought relates to specific issues of women in particular cultural contexts. In recent decades women have broadly agreed that the goal of feminism is gender equality in order to end gender discrimination (Gilligan, 1993). The modern female would not see herself as a traditional feminist. The movement has moved past looking for the causes of sexism and the quasi meta-narrative style promoted most recently looks for pathways in equity (Fleer & Jane, 2011).

Techno feminism stemmed from the work of Wajcman (1991) followed by the enduring Marxian groups represented by Spender in Man Made Language (1985 ed.). Those who assert a degree of power are in a position to construct the myth of male superiority. As part of the human condition is to attempt to make existence meaningful … we make sense of a world if we have rules by which to do it…Spender questions whose rule and who constructed the view of the world in which both sexes are accorded equal value. In a patriarchal order Spender (1985 ed., p. 2) says it is language that is the schema for creating power relations.

1.5.5 Defining Values

According to Rokeach (1973), a social psychologist, human values are defined as ‘core conceptions of the desirable’ within every individual and society. “They serve as standards or criteria to guide not only action but also judgment, choice, attitude, evaluation, argument, exhortation, rationalization, and…attribution of causality” (1973, p. 10).

Rokeach (1973) argued that the consequences of human values would be manifested in all phenomena that social scientists might consider worth investigating. In order for any type of research to be successful, regardless of the field of study, people’s underlying values needed to be understood. To allow for this, Rokeach created the Rokeach Value Survey (RVS), which has
been in use for more than 30 years. It provides a theoretical perspective on the nature of values in a “cognitive framework and consists of two sets of values, 18 instrumental and 18 terminal.” [1973, pp. 8 - 9]. Instrumental values are beliefs or conceptions about desirable modes of behaviour that are instrumental to the attainment of desirable end points, such as honesty, responsibility, and capability. Terminal values are “beliefs or conceptions about ultimate goals of existence that are worth surviving for, such as happiness, self-respect, and freedom” (Rokeach, 1973, pp. 12-13).

The Preamble to the Melbourne Declaration on Educational Goals for Young Australians (December 2008) says that as a nation Australia values the central role of education in building a democratic, equitable and just society – a society that is prosperous, cohesive and culturally diverse…. This framework differs from the earlier declarations in that it acknowledges major changes in the world that are placing new demands on Australian education. These range from global integration which heightens the need to nurture an appreciation and respect for social, cultural and religious diversity, and a sense of global citizenship. It notes globalization and technological change placing greater demands on education and skill development in Australia and the need to promote youth.

In a time of complex environmental, social and economic pressures there are challenges which can be overcome by engaging in scientific concepts and principles, and approaching problem solving in new and creative ways. (MCEETYA, 2008, p. 1).

The Melbourne Declaration on Education Goals for Young Australians

Recognises that ethical behaviour assists students to become ‘confident and creative individuals and active and informed citizens’. It does this through fostering the development of ‘personal values and attributes such as honesty, resilience, empathy and respect for others’, and the capacity to act with ethical integrity (MCEETYA, 2008, pp. 8-9).

As cultural, social, environmental and technological changes transform the world, the demands placed on learners and education systems are changing. Technologies bring local and distant communities into classrooms, exposing students to knowledge and global concerns as never before. Complex issues require responses that take account of ethical considerations such as human rights and responsibilities, animal rights, environmental issues and global justice (MCEETYA, 2008, p. 78).

1.6 Organisation of the thesis

The thesis is organised into eight chapters. Chapter 1 includes the introduction, which describes the context for the study and foreshadows the thesis content. Chapter 2 presents the examination of the research literature, which is employed to identify the topic of the cases studies as representing a gap in knowledge. Chapter 3 provides the theoretical framework underpinning the research problem. Chapter 4 describes and justifies the research methods used to investigate
the topic. Chapters 5, 6 and 7 present the results and analysis of the three case studies, while Chapter 8 is the concluding chapter which summarises what the research set out to do, what it found, how this contributed to knowledge and the recommendations that arose from the study.

1.7 Conclusion

This chapter has outlined the research questions which formed the basis of the study. It then examined the context of the study in relation to Technology Education in Australia. Definitions which are relevant to the study were foregrounded and, finally, the chapter outlined the organisation of the thesis. The following chapter presents the review of literature relevant to the study.
Chapter 2

Literature review

This chapter commences with an overview of the general developments and policies on gender in Technology Education from an Australian and international perspective. It examines current research on females in the context of Technology Education, considering ways to differentiate for gender by identifying affirmative action factors that teachers can use to work towards female engagement in post-secondary Technology Education. Five of the themes emerged from the literature while two themes, motivation and role modelling and peer support emerged as a result of the pilot study and further research.

This literature review is presented through the following seven themes associated with gender and education: (1) the ecology of learning; (2) gender and Technology Education; (3) language use in classrooms; (4) motivation; (5) role modelling and peer support; (6) socio-cultural approaches toward learning; and (7) values. These themes identify the factors that attract or deter females from participating in Technology Education classes. This literature review examines research in Technology Education in terms of how practices may influence the engagement of female students in Technology Education classrooms. This thesis examines the strategies that encourage female students to engage in Technology Education classrooms in order to increase participation rates. Research on boys and masculinity has indicated that longstanding social norms have not changed in relation to feminist views of teachers nor have the motivators for transformative approaches to gender in schools made a positive difference to practice (Keddie & Mills, 2007). These details are expanded throughout this chapter.

The research questions that are explored in the literature ask:

1. What factors have influenced female students’ choices to enroll in Technology Education classes as part of their senior school learning pathways?
2. How are teaching and learning conducted and approached in Technology Education classrooms?
3. What values are addressed in the teaching and learning within the specific context of Technology Education classes?

2.1 Outline of the chapter

The research questions focus on good practice and the factors that can be identified as encouraging female learners to Technology Education classrooms. The broad areas of research are examined firstly from both an Australian and international perspective, then each of the themes is examined in turn. Each of the themes described above becomes a lens through which the research on female engagement in Technology Education is examined. What follows is an overview of each of the themes related to gender in education. The feminist constructionist
stance (Rothschild, 1988) that this thesis adopts is outlined within the gender and Technology theme and the socio-cultural theme. The chapter concludes with the argument for the research according to the literature review that was undertaken.

2.2 Gender in education

Gender parity issues exist nationally and internationally. Globally, 39 million females of lower secondary age are currently not enrolled in either primary or secondary education; two-thirds of the world’s 796 million illiterate adults are women; and only about one-third of countries worldwide have achieved gender parity at the secondary level (UNESCO, 2012b).

The Education for All Global Monitoring Report (UNESCO, 2012b) shows the gross enrolment ratio of Australian students in secondary education in the year 2000. Of the 1,611,000 respondents, aged 12–17, the ratio of female to males was 1.01%. In net figures, this equates to 1.03% (female to male); that is, more females in this band of education than males (91% as opposed to 88.5%) of males of the total participating population (UNESCO, 2012b). Therefore, although female participation in schooling in general is not an issue in Australia, ‘streaming’ and low enrolment in classes such as Technology Education are. As an example, the figures from selected Queensland secondary schools offering Technology Education show that in 18 secondary schools, there was less than 20% female enrolment in specific classes (Queensland Studies Authority, 2012).

An Engineers Australia discussion paper (Burrowes, 2007) argues that, while Australia was a world leader in research on women in engineering during the 1990s, any gains made are going backwards and contributing to the current skills shortage. While on the increase, the numbers clearly remain inadequate.

2.3 Research themes

Each theme in this thesis is linked to good teaching practices for Technology Education. While there is a body of literature written on gender and Technology in the mid-20th century (Lerman, Ruth Oldenziel, et al., 2003) there have, however, been few in-depth studies into gender and values in Technology Education completed in recent decades, and fewer studies in the secondary school domain. In the Australian context, no research was identified that examined the National Curriculum in Technologies and the transition of females into senior secondary education. Historically there has been much written about females in education and Technology (Stanley, 1992, 1993) and the sociological relationship of women to technology, however, there has been a general absence of research that examines the factors that encourage female students to engage in Technology studies at the senior high school level. Lerman, Mahun and Oldenziel
(2003) suggest that any research on this topic has been fragmented or, at times, relegated to the ‘black box’ (Crilly, 2010); that is, generally unused and only retrieved in the case of emergencies. They cite the sluggishness of Technology historians to heed research into masculinity as a cultural dimension of traditional technology. In the context of the 21st century, there have been calls for gender research in Technology Education, but few actual in-depth studies have been undertaken. Williams (2011) argues that the move to a more sociological view of Technology Education that considers the cultural context and interactions between people will impact on future research in Technology Education.

Martin (2008) argues that females will enrol in Technology-related subjects if there are overt programs to entice them into the fields, but the long-term sustainability of such programs are not guaranteed. Historically, the short-term results do not appear to have translated into long-term gains (Burrowes, 2007). If females are given a more substantial background in Technology Education through the primary- and middle-school years, then there may be more females engaging with Technology in the senior secondary years.

Belenky et al. (1986) argue that social and cultural norms keep females out of Technology Education classes. Singh (1997) found that attitudes and values serve to heighten the division between females and males in not only Technology Education classes but also other subjects, such as science and maths, during the formative senior years of schooling. These attitudes are often held by parents, students and teachers. In examining several schools and classes that promote the engagement and participation of females in Technology Education, the study that forms part of this thesis aims to identify the strategies that will meaningfully develop teaching programs and norms to support affirmative action for females in Technology Education classes. The set of enabling criteria, the themes through which the study has analysed the data, support female participation in what is and has traditionally remained male-dominated learning area.

A significant body of educational research both in Australia and overseas has demonstrated that there is a difference in the learning styles of males and females and of the ways that this can be catered for (Fleer & Jane, 2004; Petrina, 2007). Technology educators need to not only acknowledge these differences, but implement strategies to address gender differences in their programs and their teaching. Murphy (2007) argues that teaching and learning in Technology Education need to be more accommodating to the different learning styles and values that females hold.

Following the conclusions of Fleer and Jane (2004) and Petrina (2007), researchers have identified the need for specific research into females and Technology Education. Williams and Williams (1996) argue:

There is one feature in Technology Education which is worldwide: Technology Education attracts fewer girls than boys... girls find Technology less interesting than
boys, and they see themselves in less technical jobs… (298). They claim then that girls are interested in other topics, in other kinds of activities. They feel more insecure, they need a different pedagogical approach, a different classroom climate… teachers should be aware of these problems of girls in Technology and should be aware of gender stereotypes and avoid them. (Williams & Williams, 1996, p. 299)

The Williams and Williams statement is symptomatic of the era and leaves the issue as one yet to be addressed. Subsequent research has not claimed to solve the issue of low female participation (Williams, 2011).

Throughout the 1990s and the broadening of Technology Education brought some research and academic standing to the issues of gender and Technology (Zuga, 1996). Zuga concluded that females studying Technology was important not just for the curriculum but for the value of the area itself, and Lewis (1999) argued for further similar research to be undertaken. Researchers, such as Williams and Williams (1996), Petrina (2007) and Zuga (1997) found that the majority of research was about curriculum and little was about the gender, cognitive or cultural backgrounds of learning and teaching and learning in Technology Education. There was also little research on students and teachers and the effectiveness of Technology Education (Petrina, 1998b; Zuga, 1997). Martin and Ritz (2012) concluded that there is a need to address the issue of the low representation of females and minorities within the profession. This study addresses the gap in terms of research into female participation in Technology Education at the senior schooling level.

2.4 Equity issues and background in Australia

As the following discussion will demonstrate, the recognition of equity concerns for learners in Australian education has been cyclical. The 1960s saw the liberalisation of education, which encompassed females as had never been achieved before. The era saw the promotion of females in education. Females began to complete higher levels of secondary schooling, which has continued over subsequent decades albeit in traditional classes of secretarial/business studies, home economics and social science disciplines (Lingard, 2003) at first.

The 1970s witnessed the burgeoning of women, gender and Technology studies in college courses in the United States. Lerman et al. (2003) argue that these were divided into two streams; one comprised feminist sociologists of Technology who examined the relationship between gender and technology. These were often ethnographic works examining fast-paced patterns of technological change (2003). The second stream studied gender in the historical context, and was seen as somewhat reluctant to examine the issues of masculinities (2003). Rothschild (1988) offers a critique of the status quo, suggesting that women’s values might be embodied in the designs of dominant technologies, Rothschild’s work critically challenges thinking in Technology from what men do to what people do, while altering views on what
Technology itself is. The focus on women in Technology started a cultural change for Technology Education as an offshoot (Lerman, Oldenziel, & Mahun, 2003).

During the 1980s, research by those such as Byrne (1985) emerged that examined the underrepresentation of women in Engineering and Engineering Studies. Byrne identified a number of barriers and made recommendations, including the provision of female career advisors, role models and delivery advice in non-traditional curriculum choices for senior school students.

### 2.4.1 Gender in national education policies

Reflecting on the national development of educational policies during the 1990s, Yates (1997) notes the emphasis on the social construction of gender from the early years through schooling and an alignment that was to be part of syllabus and pedagogy. The first *National Action Plan for the Education of Girls 1993–1997* (Australian Education Council, 1993) was published in the early 1990s. Several Australian state education departments followed. However, the movement did not sustain itself and was overtaken by the publication of *Gender Equity: A Framework for Australian Schools* (Ministerial Council on Education Employment Training and Youth Affairs (Taskforce, 1997), which reflected masculinity and the positioning of equal advantage (Lingard, 2003).

Through research grants, the Association of Women Educators published *Gender up Front* (Nayler, 1997). While addressing topical issues it has remained a seminal reference for Australian females in schools.

The concern for boys in the equity debate was addressed with the 2002 report *Boys: Getting It Right* (House of Representatives Standing Committee on Education and Training, 2002). Subsequent reports and research emerged that there was a need for boy-friendly strategies and the focus again turned from girls to programs such as the *Boys Lighthouse Schools* (Australian Government, 2003) and *Success for Boys* (Alloway & Dalley-Trim, 2006) stemming from the 2002 report.

Ollis (2011) argues that, in the context of the resurgent interest in issues of masculinity and the lack of government policy to redress the issues for females, the 2000s saw a return to the stereotypical gender roles and behaviours that already existed in schools.

Educational knowledge and curriculum and the language used in educational settings replicates the dominant or mainstream culture and educators are well positioned to provide a positive model for influencing and challenging sexism, both overt and covert... (Ford, 2011, p. 5).

By the mid-1990s, every Australian state education department had established a gender equity unit, and gender equity policies were being developed at all levels.
A decade into the new millennium, concern for gender justice has been reconstructed in Australia. Writers such as Connell, Fawcett and Meagher claim that neoliberal economic rationalism has shifted the focus of schooling to the “production of future workers” (Connell, Fawcett, & Meagher, 2009). Concerns about academic outcomes, client ‘choice’, and competition have further sidelined issues of social justice and pedagogy. Public culture and education reforms have come to reflect, without critical view, the dominant state ideology. Equity has become mostly underpinned by mere rhetoric of democratisation (Blackmore, 2011). Equity and diversity discourses have been appropriated into institutional objectives, which align with neoliberal discourses about individual choice and have diverted attention from systemic and cultural factors (Davies & Banks, 1992). A range of simplistic, gender-neutral, antifeminist and essentialist discourses and understandings about gender dominates and drives school curriculum and pedagogy (Keddie, 2006). Approaches that have been criticised as promoting narrow and oppositional constructions of masculinity and femininity are serving to constrain gender justice (Connell, 1995, 2000; Keddie & Mills, 2007). Ollis (2011) argues they have become embedded in our schools through lack of guidance and policy.

Examining the processes in science and mathematics education in its quest to implement gender equality is instructive. The writings of Parker and Rennie (2002) and Kahle, Parker, Rennie and Riley (1993) point to policy and strategies that can be implemented in curriculum content areas. Matters, Allen, Grey and Pitman (1999) grappled with the same issues for senior secondary schooling and yet there is no final outcome.

Blackmore (2006) claims that in order to bring about change, there is a need for democratic deliberation in education. She asserts that feminist policy work is a situated, social and collective practice undertaken by different people, informally and formally, in different contexts. Such change must be grounded in process and brought about by dialogue at many levels (2006).

Davies and Banks (1992) argue that equity committees were paying homage to the notion of inclusion and serving to maintain a long-held tradition of the status quo: …equity programs which simply introduce the idea of equity, and which rely on role models and access to non-sexist curricula, will not be enough to disrupt these strongly held theories of gender and patterns of desire. (Davies & Banks, 1992)

The problem of the disproportionate involvement of females in the STEM disciplines is noted by Weber and Custer (2005), Sanders, Koch and Urso (1997), and Byrne (1985). Researchers have concluded that this lack of participation can be attributed to curriculum content that is biased towards males’ interests. Others, such as Petrina and Hill, attribute the lack of interest to pedagogical approaches rather than to the inherent nature of the subject. Petrina (2000), TjAA Project (2003) and Hill et.al. (2010) conclude that the linking of gender and values with the concepts within technological literacy will benefit learning in Technology
Education classrooms and led to an increased participation of females. Studies in technological literacy have demonstrated the benefits of cross-curriculum learning; for example, Knopke (2002) demonstrated how Technology Education content could be integrated with other curriculum areas. In this case, altering the pedagogy altered the outcomes for the students and the uptake in primary Technology Education.

At these case study sites, gender issues were addressed but not developed in depth due to the scope of the study (Knopke, 2003). As an outcome of the study, it was noted that a specialist study to investigate the nature and development of boys and girls and their interactions with various types and forms of materials is required. In concluding the study and referring to the dimensions of the models presented, it was noted that “the social considerations of gender are imperative when considering what underpins programs that are to be constructed for primary schools in the state [Queensland]” (Knopke, 2003, p. 186).

Technological literacy is a complex embodiment of concepts that underpin Technology Education. Researchers such as Dakers (2006) and Martin and Ritz (2012) have argued for research priorities in these areas. Over the preceding decades, academics have returned to this theme (Dakers, 2006), and stress that if practitioners understand what underpins Technology Education and have it clearly defined, then there is a sound theoretical background on which to build.

2.4.2 2012 Report for Australia

A 2012 report *Mathematics Engineering & Science in the National Interest*, by the Chief Scientist to Government, concluded that Australia is still reasonably placed in the Programme for International Student Assessment (PISA) rankings, despite being overtaken by an increasing number of other countries over the years (Australian Government: Office of the Chief Scientist, 2012) (see Table 2.1).

| Table 2.1 Countries That Outperform Australia in PISA Testing |
|-----------------------|-----------------|-----------------|-----------------|
| Korea, Japan          | 2003            | 2006            | 2009            |
| Korea                 | Finland         | Finland         | China, Finland  |
| Japan                 | Finland         | Hong Kong       | Hong Kong       |
| Korea                 | Korea           | Canada          | Singapore       |
|                       |                 |                 | Japan           |
|                       |                 |                 | Korea           |

While the PISA measurements examine Mathematics and Science, but not Technology, it was the measure used in Australia to compare our education ranking with others with regard to the STEM subjects.

Barriers to increasing the numbers of STEM graduates include the perceived difficulty of STEM subjects; the disillusionment with the transition from primary to secondary school; the negative views about success in STEM; and negative stereotypes and career opportunities for
females (Australian Government: Office of the Chief Scientist, 2012). It is no coincidence that the countries that now outperform Australia are those that have taken steps to increase the proportion of mathematics, engineering and science (MES) graduates (Australian Government: Office of the Chief Scientist, 2012).

The Chief Scientist’s report argues that teaching needs to be of a high quality and inspirational while content is generally seen as irrelevant to life after school. Currently, teaching is seen (by students) as boring because so much is seen as knowledge transmission of correct answers with neither time nor room for creativity, reflection or offering opinions and that there were negative stereotypes (2012). The report argues that educators need to be aware of and see the value in MES career pathways (Australian Government, Office of the Chief Scientist, 2012). In summary, the development of effective and attractive STEM curricula and teaching methods, and improved teacher education and professional development, are essential to making STEM studies and careers a more popular option for both male and female Australian students, especially when compared with Asian neighbours.

2.5 International reports

In its vision, Education for the 21st Century – Educating for Sustainable Development to 2014, UNESCO (2014) sets out the following criteria for professionals in education systems to aim for: prepare learners to enter the workforce, handle a crisis, become responsible citizens, adapt to change, recognize and solve local problems with global roots, meet other cultures with respect and create a peaceful and sustainable society. The sustainable-development initiatives for post-2015, from the report, further recognise the need to educate females in order to address issues of poverty and advancement (2014).

This current study suggests that the criteria, goals and aims stem from values and these are associated with gender. An earlier UNESCO report Learning: The Treasure Within (De Lores, 2000) recognised economic growth to human development as one of its outlooks, which pinpointed education for women as a means for promoting development.

International reports, such as Non Traditional Career Preparation: The Root Causes & Strategies (Reha, Lufkin, & Laurie, 2011; Reha, Mimi Lufkin, & Laurie Harrison, 2009), conclude that there is scope to develop and address a large number of the causes identified in the report. Now is the time to take action for both genders. The UPDATE project of the European Commission’s Sixth Framework Project (Dakers & Dow, 2009) collated updates on pedagogy and developmental approaches to Technology Education with the aim of encouraging both sexes, but females in particular, to engaging the STEM subject areas. Why so few? (Hill et al., 2010) have raised issues of the lack of numbers of females in the STEM area.
2.5.1 **International research on gender and technology**

Hong, Hwang, Wong, Lin and Yau (2011), in a project-based qualitative research study, concluded that there was little difference from males to females in Technology learning apart from time management and a lack of knowledge base on the girl’s part. The Hong et al. study did not utilise a feminist critique nor seek an in-depth investigation on gendered issues. Hence the current study is filling gaps that have not been addressed in recent studies. The findings of Weber and Custer (2005) and Stables (2008), based on classroom observations, were considered in the design of the data collection methods for this study. Their work cites technologists such as Oldenziel (2003) who argue that one should not presume that boys or girls will ‘naturally’ like certain things.

Murphy (2007) highlights the historically gendered nature of the history of technology, and concludes that teachers can adopt teaching strategies to address the issue of teaching females and males in technology. Dakers and Dow (2009) reported that little had changed around the nature of gendered engagement in Technology Education classrooms despite scholarly writings on the issue.

Stevensen (2008) notes the problems of determining what knowledge should be captured and then be the target of instruction in Technology Education and the implications for teaching. Lewis (1999) argues that Technology Education needs research into not just the vocational areas but also into those of gender where there is unlimited potential.

In summarising the focus of research and reports in Technology Education by way of a ‘trajectory’ for future research trends, Williams (2011) suggests that while some are seminal, in general, they are inadequate. Petrina (1998) and Zuga (1997) found that research was about curriculum but little about teaching and learning in Technology Education. These conclusions by Williams (2011), Petrina (1998a) and Zuga (1997) are important and support the need for the study that forms part of this thesis.

The following outlines the themes that emerged from the literature review.

## 2.6 Review of the themes

The seven themes that emerged during the literature review are as follows: learning ecology, gender and Technology Education, language use in classrooms, socio-cultural approaches to learning, and values within Technology Education. These themes shape the classroom learning ecology in which students operate. Two other themes emerged as a result of the pilot study and further research. These were; motivation and role modelling and peer support. Collectively, the themes shaped the interview questions and observations used while visiting the case study sites.
2.6.1 Learning ecology

The first theme identified in the literature review is the ecology of learning in Technology Education classes. Certain pedagogical strategies are inclusive of females in Technology classes (Nystrand et al., 1998), and the literature examines effective principles that encourage females to want to be and remain in those classes in terms of classroom practices and how females learn. In examining feminist perspectives, Rothschild (1988) points out that achieving gender equity in Technology classes is not about adding women and stirring. Essentially, the courses would remain unaltered except for having met a random target for the inclusion of females. This was found in the past, when programs to increase the enrolments of females were implemented (Rothschild, 1988). The short-term target is met but the long-term results are the same or lower than the starting point (Rothschild, 1988; Tembon, 2008).

A review of literature on activities at the classroom level identified potential disincentives for females to engage in Technology Education (Davies & Banks, 1992). More recent research (Keddie & Mills, 2007) on boys and masculinity has indicated that, since the 1980s, social norms have not changed in relation to feminist views of teachers nor have the drivers for transformative approaches to gender in schools made a difference to practice (Davies & Banks, 1992; Keddie & Mills, 2007). Given the development of policies and procedures over the previous decades, as outlined above, there has been little impact on changing practices to cater to more female participants in Technology Education.

The learning ecology literature (Nystrand et al., 1998; Schwab, 2013; Siemens, 2006) led to research in two areas: firstly, effective classrooms and good practice; and secondly, approaches that affect marginalised groups. ‘Ecology’ has been defined by Siemens (2003) as an environment that fosters and supports the creation of communities. A learning ecology is an environment that is consistent with how learners learn.

2.6.1.1 Effective classrooms, good practice and the learning ecology

On the basis of the social environment within a classroom ecology, the following literature and discussion examines the criteria for effective classrooms and good practice in relation to the way females prefer to learn. Are there pedagogical strategies that are used to encourage females in Technology classes? What are the effective principles which entice females to want to be in these classes and remain there for the completion of their Technology studies?

Schwab (2013) examined the four common pillars of learning which established the context for learning by way of the process which would involve learners in engagement for learning. The four pillars that shape any learning environment are as follows: students; teachers; the milieu; subject matter. It is the higher levels of inquiry that change how students will engage in the created ecological learning environment (Schwab, 2013).
Pedagogical ecology concerns the relationships of instructors and learners in learning environments. Hawley (1986) has examined these symbiotic interactions to discover insights about the course and parameters of individual organisms' behaviour and development. On the one hand, ecologists study grand eco systems. On the other hand, they study far smaller and more particular ecological niches (Nystrand, Gamoran & Carbonaro, 1998). In education, school systems are analogous to ecosystems whereby reading rituals, response groups, and individual class contexts are more properly regarded as ecological niches (Nystrand et al., 1998; Pavlova, 2009).

Ecological niches are distinguished by the “reciprocal, mutually dependent roles of their particular members: what one does has implications for what the other can do. In environments dedicated to learning, the roles are also epistemological, and it is the discourse between participants that defines the operational epistemology of the group” (Nystrand et al., 1998, p. 5). In a co-ordinated environment, the instructor will provide the scaffold for learning, while the learner, continually honouring the teacher’s role and perspective, will use their emerging skills. According to Nystrand et al. (1998), these skills are shaped by the relationship and interactions of instructor and learner and peers. Peer support that stems from the social notion of gender and functionality is part of the ecology of the Technology classroom that will be examined.

Nystrand et al. (1998) argue that the social, emotional and technical support individuals provide through actions and gestures within the classroom setting defines the learning ecology and provides positive networks within classrooms. The context is dynamic and evolving according to the shifting roles of the group. Finally, their relationship is reciprocal: development is elegantly understood here as the learner’s expanding role enabled by the instructor’s receding role in a joint activity; their roles can shift precisely because reciprocity remains constant. Learning is successfully promoted when teachers effectively build on students’ prior knowledge and current understandings; for example, by following up on student responses and ensuring success. As the authors write:

Discourse in these classrooms becomes a more open-ended practice and one of mutual development in which teachers validate particular student ideas by incorporating their responses into subsequent questions, a process of ‘uptake’. (Nystrand et al., 1998, p. 5)

2.6.1.2 Approaches that affect marginalized groups

De Vries, Custer, Dakers and Martin (2007), researching instructional design, note the need for varied teaching approaches. Writing on the Technology Education classroom, Benjamin (2002, p. 1) defined ‘differentiated instruction’ as a term referring to a variety of classroom practices that accommodate differences in students’ learning styles, interests, prior knowledge, socialisation needs, and comfort zones.

Bernstein (2003) talks of the ‘code’ and ‘modality’ of pedagogic transmission and acquisition that affects learners. Codes can position subjects into dominant forms of
communication through selecting and integrating meaning onto the subject. Bernstein also examines power and control of the subject matter and cultural context; he argues that gender, ethnicity, race, religion can each generate their own ‘voice message’ that can be transmitted in various ways to position subjects to both discursive and physical resources.

The technique of building sustainable communities has been used in United States classrooms in studies of young African-American students (Blewitt, 2006) as well as with the learning disadvantaged (Smith, 2009). Brown (2000) has written on the concept of a knowledge ecology. Brown defines ecology as an open system, dynamic and interdependent, diverse, partially self-organizing, adaptive, and fragile. This concept is then extended to include the following characteristics of a learning ecology: a collection of overlapping communities of interest; cross pollinating with each other; constantly evolving; and largely self-organizing.

As argued below, learning ecologies can exceed the characteristics. In more formal education environments, the concept of self-organizing gives way to a more structured process for knowledge transmission (Brunner & Bennett, 1997). Brunner and Bennett (1997) argue that learning and knowledge is more than static content. It is a dynamic, living, and evolving state and that within any classroom ecology, a knowledge-sharing environment should have the following seven components:

[Firstly, it should be] … informal, not structured. The system should not define the learning and discussion that happens. The system should be flexible enough to allow participants to create according to their needs. Secondly, that they are tool-rich – many opportunities for users to dialogue and connect. Thirdly, that they have consistency and time. 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. Next, that there is trust. Trust is high for social contact whether it is face to face or online. Trust is needed to foster a sense of comfort in a secure and safe environment … Simplicity is the fifth element in the ecology of a classroom. 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. Learning in classrooms is ideally decentralized, fostered, connected...as compared to centralized, managed, and isolated. The seventh and final element is a high tolerance for experimentation and failure. (Brunner & Bennett, 1997, p. 47)

As argued by Brunner and Bennett (1997), learning in this type of community has a student-centred, social constructivist style that encourages teens to engage and grow. A 2012 report on STEM (Modi, Schoenberg, & Salmond, 2012) identifies not simply the learning environment that females like to learn within but also a unique group that become the face and embodiment of females learning in these subjects. This report notes that women and girls in STEM are faring far better, academically, than ever before.

Research by Blackmore (2011) on feminist educational thinking suggests that the discourses of educational change since the late 1990s have held promises for feminism and that
the transformations for women in education have brought about changes in social relationships in education. Blackmore (2011, p. 208) suggests that “in an era of post masculinity, women need to exhibit strength, strong relations, care and collegiality”. The feminist critiques (Keddie, 2012) would propose that there is a political agenda which needs to be addressed before the gender divide can be meaningfully changed.

The Hong et al. (2011) research examined the engagement of females in Technology Education while the Weber and Custer (2005) study developed an in-depth view of a number of Technology classrooms and the topics to be studied. Their study is important in identifying the topics that female students prefer to study in Technology Education. However, the Weber and Custer study did not examine effective short- or long-term reasons female students would attend Technology Education classes, which is the focus of this thesis.

In a limited study on career options and gender awareness, Ford (2011) concluded that career counselling for many females at the year 9 and 10 level was ‘passe’ (2011). Not only are gender constructs already formed but prevalent classroom practices perpetuate the stereotypes of inept and dependent females and the active male hero. This mirrors gender stereotypes that exist throughout society and is part of what is referred to as the hidden curriculum or gender blindness: circumstances where gender bias is so normative that it escapes scrutiny (Ford, 2011).

Articles by Williams (2011), Middleton (2008), and Lerman, Mahn and Oldenziel (2003) have shown that there are studies in the field but few applying to this topic. Many try to cater to difference and marginalised groups. The notion of technological actors (Wajcman, 2004), sites and spheres have been addressed along with frequent artefact studies (Williams, 2011; De Vries, 2009). Previous studies in Technology Education and gender can be grouped by the following headings in addressing marginalised groups:

- Actors and ages of the studies and the participants (Petrina, 2007; Wajcman, 2004)
- Micro studies within classes as to what students wished to study (Weber & Custer, 2005)
- Teaching and learning – pedagogic issues (teaching about women and Technology (Rothschild, 1988)
- Gender awareness (Wajcman, 2004)
- Teacher allocated time and engagement (Petrina, 2007)
- Technological literacy and engagement for process engagement Technology (Dugger, 1995)

Research by Hill, Corbett and St Rose (2010) on the STEM movements of the 2000s addressed issues of technological literacy as has the Technology for All Americans project. Technology Education Research conferences such as the Pupil’s Attitude To Technology (PATT), which examines globalisation and knowledge in Technology Education, all acknowledge elements of gender and issues that require attention. De Vries (2009) and Williams (2011) conclude that practical (in class) research is what is missing from the literature.
Knopke (2003) found that female students needed skill development and exposure to manipulative materials at an early stage. The Lego case studies and Lego research have produced the same findings (Knopke, 2003). The need for gender research and focused gender teaching again arises from this point. Knopke concluded that the social models that are adopted in primary (elementary) schools are already age gender bias against being part of a technical oriented workforce. At an early age female have received and had reinforced the notions about engagement or lack of knowledge and willingness to engage in hard resistant materials projects and electronic technologies.

Within the STEM movements, however, the emphasis and funding remain focused on Science activity rather than Technology. In Australia, this is mostly attributable to the foregrounding of Science in the ACARA curriculum planning (ACARA, 2014). It has been an international trend that STEM has focussed into the Sciences (Dakers, 2007).

The feminist critique applied in this study looks to the voices of the female participants. It is the hidden voices with their hidden socio-cultural agendas that will elucidate the untold story from within the socio-cultural framework. The following section on gender and Technology outlines the feminist approach which has been adopted.

### 2.6.2 Gender and Technology Education

#### 2.6.2.1 Feminist literature

Feminist critiques such as those of Rothschild (1988) and Wajcman (1991) have brought a broader perspective to the study of Technology Education but there is, as yet, no clear end point. Destination points have varied with political eras such as those described in section 2.4 of this chapter.

Feminist empiricists, such as Lerman, Oldenziel and Rothschild (2003), worked within the positivist tradition to ‘deconstruct’ what they perceived as errors within their disciplines. Their objective of eradicating sexist research was to include women’s concerns in research endeavours. The aim was to raise awareness of the place of females in education as much as in relation to technology and its use.

This review examines data and literature that shapes the criteria that not only affects marginalized groups but could be used to improve the environment of Technology classrooms for the benefit of female’s participation.

Hess-Biber (2013) argues that ‘feminist objectivity’ can be described as objectivity in which knowledge and truth are considered partial, situated, subjective, power imbued and relational. The concern with any feminist perspective of the social world is to create a more socially just world. Feminist research, via qualitative research, aims to capture the subtleties and nuances of women’s lived experiences.
Feminist research methods are fluid. Methods, in this sense, are tools and techniques employed to answer the research question and do not have an inherent femininity. What make feminist research ‘feminist’ are the perspectives and research questions that focus on the lives of women. These questions of power, difference, silence, and oppression with the aim of moving to a more just society…. Feminist research is then about studying by listening to the voices of women, exploring and empowering their experiences and examining the connection between power and knowledge. (Hesse-Biber, 2010, p. 129)

This literature review does not support the situated knowledge belief of feminist objectivity. This is because knowledge and truth are imbued with values, bias and politics (Hesse-Bieber, 2013). It is not about positional knowledge where women analyse the gaps that occur in everyday experiences and work to fit into a social space of their personal perspective and that of their oppressors. Hesse-Biber (2013) argues that feminist standpoints vary and there are issues of difference in many fields. Issues of gender, race, ethnicity and class as well as those of sexual preference, disability and nationality should be considered in parallel given the social era we now live in.

On the basis of the literature, this thesis adopts the following notions that, feminist researchers:

- Ask new questions: strive to give voice to women’s experiences especially related to knowledge that traditional research approaches have marginalized.
- Look to reach multiple understandings of the nature of social reality, especially for women’s concerns and standpoints.
- Address issues of difference by studying across difference, gender, race and class.
- Stress the empowerment of women in research process using reflexivity (awareness of power imbalances (researcher and participants), while being mindful of research concepts and listening) throughout.
- Know the importance of social justice, social transformation and social change on behalf of women. (Hesse-Biber, 2010)

2.6.2.1 Feminist Constructionist views and technology

This thesis takes the positivist (logical, rationalist) perspective of Hesse-Biber (2010) in unearthing the voices of females in Technology Education. Modern socio-cultural liberal feminism and awareness of gender issues enables young women to move past their historic roles in society to achieve some degree of equality in learning (Hesse-Biber, 2013). Hesse-Biber argues that it is awareness and a willingness to achieve that is sustaining a change in what is coined the ‘Technology Education pipeline’.

Socio-cultural approaches to learning provide instruction that recognizes and empowers linguistically and culturally diverse students (Bernstein, 2000). Socio-cultural theory describes learning as distributed, interactive, and contextual and the result of a learner’s participation in a community of practice (Bernstein, 2000). The collaboration of thinking that results from these processes provides avenues to uncover distinguishing characteristics that can lead to change and
transformation, which links to changing cultures in classrooms for the betterment of the female participants (Bernstein, 2000).

Bijker (1995) argues that learning within a techno-social sphere may be the best environment for females. Bijker claims that there is a continual process of closure, reflecting on aspects of technical change and stability over time, which shows that everything can fit into a technological frame consisting of knowledge, goals, and values as well as artefacts (1995).

Postmodernist theories such as Wright's (1992) feminist theories encourage diversity in their view. As Flax (1990) writes, “Feminist theories, like other forms of postmodernism, encourage us to tolerate and interpret ambivalence, ambiguity, and multiplicity as well as to expose the roots of our needs for imposing order and structure. If we do our work well, reality will appear even more unstable, complex, and disorderly than it does now” (1990, p. 643). Both postmodern and feminist theories point to diversity as a direction for the future and one that can provide some of the ideology for Technology educators' avoiding a restricted cultural view and creating change in the profession (Zuga, 2007).

Zuga (2007) and Wajcman (2004) have examined the sociotechnical constructivist approaches that emerged from the teaching of feminism in America. These studies were modified from social studies of technology. The characterisation of Wajcman’s ‘techno-feminist’ (females who had embraced technology) represented a major development in theorising the gendered character of technology. Haraway’s ‘cyborg-feminists’ (females who were joining the techno age and engaging in cyber and computer-assisted technologies) and socialist feminist inquiry was pivotal in exposing the gender blindness of mainstream technoscience studies (Wajcman, 2004). Haraway and Wajcman showed the possibilities this area offers women and how they could strategically engage with technoscience in a connected, wired world that was not dependant on gender (Wajcman, 2004).

Durack (1997) argues that in order to bring about change in Technology Education, people need to raise gender consciousness and the feminist uses of the construction of ideas and the delivery of programs in the broad area of Technology Education. Biological differences between sexes do not determine gender, gender attributes, or gender relations. Gender, argues Haslanger (2005), is a constitutive social construction, a social category whose definition makes reference to a broad network of social relations, not anatomical differences. 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).

Boe et al. (2011) and Thaler and Zorn (2010) have concluded that the artefacts to be made by students and freedom of choice in the learning process has the most effect on students’ motivation as participants in Technology Education. Campbell and Jane (2012) demonstrate that for some students, elements of individual choice affect their intrinsic motivation. By expanding the amount of internal feedback, their feelings of high levels of autonomy, choice and self-
direction provide an apparent freedom of choice in materials (autonomy), techniques, and products to be made. In their study, student motivation appeared to rise through more active engagement and perseverance. Similarly, Autio (2013) argues that self-confidence and expectations for success give value to the options available to females in Technology Education classes.

Technology Education continues to be perceived as masculine in nature, procedural in delivery and lacking a conceptual dimension. Such an enduring perception serves to restrict female interest in the subject (Dakers, Dow, & McNamee, 2009). Similarly, Klapwij and Rommes (2009) identified the problem with stereotypes, such as “women prefer working with people and men with things”; as they note, “if we repeat it often enough, it becomes the norm. … Repetition makes it impossible to loosen the unilateral connections” (Klapwij & Rommes, 2009, p. 406). To change from the stereotypical images and perceptions of the past, educators need to break social perceptions.

The studies noted above suggest that gender engagement and motivation can be raised through addressing Technology Education as a positive concept that females, if they come into contact with often enough, may consequently develop skills and knowledge in the area. Frequency of exposure and role models can be the link between Technology and femininity (Dakers et al., 2009; Kolmos, Mejgaard, Haase, & Holgaard, 2013). Wajcman (2004) would argue that the concept links back to a masculine definition of Technology and dominance as it remains part of a male-driven discourse.

### 2.6.3 Language use in classrooms

The third theme of this investigation examines the gendered use of language. This is based on a values system that parallels the feminist perspective and is inherent in national, state and local notions of values for schooling in Australia (Government, 2007). The concept of language and gender as examined by researchers such as Spender (1980) is pivotal in this investigation. Challenging the cultural norm of language and how teachers address students and their subject area may serve to illustrate some underlying cultural assumptions. The frequent theme of the masculine language of invention identified by Oldenzel (1997), (Bijker, 1995), and Eckert and McConnell-Ginet (2003) may serve to show why females do not readily participate in this learning area. It may be at this point with language conveying the essence of the subject that females in schools form an opinion of the subject and its applicability to them and their engagement. Ford (2011) argues that it is during the early years of education that these decisions are made. Talbot (2010) argues that language is both historic and culturally embedded and, like Spender (1980), sees little that will provide a path forward because of what she describes as the hegemonic domination of males in society.
Ford (2011) has examined pre-school Technology Education classes and argues that one must question when opinions are formed by female students about what they will study. Are opinions formed via the language used or social expectations? Is it the curriculum enactment which shapes the engagement of females in the subject? In examining the data from female’s participation and performance in post-compulsory Technology Education subjects, it is evident that less than 10% of enrolments are females but those females who do enter the classes achieve higher level results than their male counterparts in many instances (QSA, 2010).

Spender (1980) argues that men control language, which in turn works in their favour. Spender’s research has found that men had use and control of more positive language and thus ensured themselves the opportunities to use this from a power perspective. Spender (1980) explores the theory of good conduct broken by the suffragettes who paved the way for some yielding of power. Eckert and McConnell-Ginet (2003) and Talbot (2010) examine issues of difference and issues of dominance that shape the language used by males and females, and find that males continue to dominate interactions.

Stanley (1992; 1993) cites authors who talk of the silence of women in technological developments throughout history. Stanley notes that, over time, technical activities related to men have been seen as technological and engineered while those related to women have been seen as craft and home making. Stanley (1992) demonstrates that, historically, and in various fields of endeavour, the focus from female to male activities has altered from industry and war efforts to home and business pursuits. Singh (1997) refers to the discourse related to the computer, the production, transmission and acquisition of school computing knowledge as shifted from a male to female model. That the social structure for this knowledge is a device, which, at the time, was used as a 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 (Singh, 1997). The aim of the Federal and State Labor Governments during the 1980s in Australia was to link the language of computing to the marketplace but also to produce technologically literate workers for the needs of industry and this was tied to the social justice platform of gender equity (Singh, 1997).

In writing on techno feminism, Wajcman (2000; 2004) highlighted that we are at an intersection of feminist studies, technoscience and science, Technology and society. The age of communications should lend itself to a bright future for Technology that does not hinder 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 that are tied to male social networks. In *Feminism Confronts Technology* (1991),
Wajcman strongly puts the case for developing feminism in social science debates in technology. Wajcman argues that technological change impacts differently on women and men. How females perceive the subject area may be through environmental and social influences just as has been illustrated through the use of artefacts. These are examined under the socio-cultural heading in this chapter.

The use of language and the hidden curricular appears to be the deterrent for females. Blackmore (1999) suggests that there is power through discourse.

‘Discourse, as a systematic set of meanings, circulate around practices of institutions (such as education) but also exist globally and locally around cultural and social practices and regulate how we understand uses of language which occurs at the political, cultural and small group level. Discourses shift to accommodate, modify, appropriate and resist more disruptive elements in order to maintain hegemony. They shape boundaries, have material effects (distribution of resources) and arise out of as well as produce particular historical conditions’. (Blackmore, 1999, p. 16)

Zuga (1996) argues that Technology Education curriculum, employing language about Technology that is intended for all students, needs to incorporate the diversity of people, positions, and values in order to reach students and to serve as a socially valued subject in the school curriculum. Dakers (2006) argues in a related way that technological literacy and its links to language; values and understanding may provide the criteria and links to teasing out the actions in classrooms and school settings. The following examines the fourth theme of motivation.

2.6.4 Motivation

The fourth theme is that of motivation. Motivation is defined in the broadest sense as “the process whereby goal-directed activity is instigated and sustained” (Pintrich & Schunk, 2002, p.110). This theme has been divided into several areas: motivation and self-values in youth; motivational strategies and gender, including social values and personal values and self-efficacy; and the level of challenges we give youth.

Successful classrooms and practices which attract female students as Technology Education learners are the subject of the study. Classrooms that effectively engage female students in Technology Education and the learning and pedagogy within this domain are those to be identified (Weber & Custer, 2005).

Belenky et al. (1986), Rothschild (1988) and Wajcman (1991; 2004) have examined factors that could assist females to achieve in technologsphere-oriented studies. (A term coined by Wajcman as any area of connectivity related to technology). Factors such as combinations of pedagogy and effective teaching principles provide the best possible motivation for female students in Technology Education classes are what the studies focused on.
Research into adolescents and motivation, skills and abilities (Fuller, 2008) shows the effect of positive classroom environments on youth. Research on brain plasticity learning and memory (Hill, Corbett & Rose, 2010) serves to further the argument of Fuller (2008) that, if youth continually receive the same new messages, then they take on new concepts. If the socio-cultural message is unchanged, then there will never be the ability for adaption and reorganisation of neural pathways to take on changes.

Neural research (Kolb & Whishaw, 1998) has shown that the human brain expands and changes over a lifetime as synaptic pathways alter. The brain will change with learning as the plasticity is the storing of new data, which, in time, can be moved via anatomical or biochemical changes to long-term memory and as youth develop learning pathways, interactions and emotional reactions. Change in social beliefs and acceptance can occur but only if there is an altered pathway to a new concept that females can participate in Technology as much as male learners.

2.6.4.1 Motivation and self-values in youth

The following examines elements that motivate modern day youth to engage in non-compulsory Technology Education. The origins of personal and group motivation have been explored in terms of how youth utilise self-values to engage in Technology Education practices that schools program for them (Pintrich & Schunk, 2002). Of particular interest are the steps taken by schools to engage females in technology-centred programs. Australian data (Australian Government, 2012), in line with European data (Dakers & Dow, 2009), show that young female learners are not articulating through to maths, science, or Technology classes into STEM related tertiary fields (Boe, Henriksen, Lyons, & Schreiner, 2011; Engineers Australia, 2012). The figurative pipeline mentioned earlier refers to the point where students commence in Technology Education and then continue to engage along a continuum of studies related to Technology Education with a view to a post-school pathway. Given that all students in lower secondary high school (Years 8 and 9 in Queensland) participate in some studies in Technology, female students need to be encouraged to remain in the Technology pipeline and to thrive to reach senior secondary levels and beyond (Saunders, Goldenberg & Gallimore, 2009).

The work of Pintrich and Schunk (2002) and Ford (1992) is examined in terms of motivation and its effect on the learning styles of female students along with its influence on engagement in school settings and how this, along with familial influences, can alter learning patterns.

2.6.4.2 Motivational strategies and gender

Reportedly, women are attracted to careers that help people and work with them to enact communal goals (Colvin, Lyden, & León de la Barra, 2013). If females are provided with more
knowledge of how careers in the STEM fields could be a vehicle to enact altruistic goals and values, they could be prepared to go along the STEM pathway (Colvin et al., 2013). Social values are ranked highly by female students (Weber & Custer, 2005). Research in secondary schools in Queensland has shown that appropriate values can and do motivate students in Technology Education classes. Internal and external values identified by Pavlova and Turner (2007) came into play at different points of learning for students. Instrumental values such as those with an immediate purpose meant more for students starting in Technology Education classes. Learning for fun or for life skills was important to begin with. As students matured over time, the terminal values of life and career goals came into play and the purpose for participating in Technology Education changed. Driven by internal values, students were self-motivated to achieve in order to reach their end goals.

2.6.4.3 Personal values and self-efficacy

Self-efficacy is a strategy in motivating female students in Technology Education. A belief that one has the capabilities of exercising courses of action to manage certain situations is seen as a positive predictor of achievement in task-specific goals and success for women in non-traditional career areas (Marra, Rodgers, Shein & Bogue, 2009). Cognitive and metacognitive skills focussing on self-efficacy provide motivation to learn. Marra et al. (2009) have examined positive outcomes that were achieved with female students to identify the factors that contributed to student satisfaction, achievement, and ultimately, retention in engineering programs. Marra et al. found that influencing environments and sustained persistence enabled mastery experiences in complex design projects. This occurred in cases where strategies such as instructional demonstrations and encouragement were used. These positive successes led to long-term participation by female students.

2.6.4.4 Level of challenges

In the Marra et al. (2009) study, self-regulation and the level of challenge that the females set themselves, the amount they mobilised and persisted in the face of difficulties refers back to their level of self-efficacy, confidence and the support provided by both peers and teachers. Ultimately, Marra et al. found that female students’ achievement in the design task stems from the motivational factors that came into play.

The following examines the fifth theme of role modelling and peer support. This theme follows from the motivational lens and links to the socio-cultural theme of how female learners appear to choose to learn best.
2.6.5 Role modelling and peer support

This theme emerged as part of the pilot study followed by an examination of the literature and is closely aligned with motivational factors and communities of interest. It takes into consideration the social factors that teens identify with.

Role modelling refers to the individuals who support learners and the guidance given to participants in given situations. Pintrich and Schunk (2002, p. 384) refer to part of this support as “peer networks”. These networks are groups with whom students interact in a socio-cultural manner. There are further role models of older, respected and familial people in the lives of students. Individuals model themselves on and learn from a range of people. Toren (1996) argues that the human activity in terms of the research relates to the social interactions that can be observed.

The social constructionist view toward role modelling defined by Shotter and Gergen, 1994, in Potter (1997) has given voice to a range of topics, such as the social construction of personal identities; the role of power in the social making of meanings; rhetoric and narrative in establishing sciences; the centrality of everyday activities; remembering and forgetting as socially constituted activities; reflexivity in method and theorising. The common thread underlying all these topics is a concern with the processes by which human abilities, experiences, common sense and scientific knowledge are both produced in, and reproduce, human communities. It is the combination and complexity of these concepts that shape youth, who are the learners in the Technology classrooms.

A feminist constructionist stance sees gender as a construct (Oldenziel, 2003; 1999). The construct is not created by nature as a result of biology but rather created by and contingent on social and historical processes (Stanley, 1993). To prepare students for the future, Technology educators must seek alternative ways to conceptualize their subject matter to reach the diverse population of citizens in society (Wright, 1992). Technology educators must rethink the way in which they legitimize the knowledge of Technology Education for students in order to meet their needs and wants. Wright (1992) stated that the social commitment must legitimize the principle of difference to encourage and multiply different kinds of people and positions and values for their own sake within the bounds of social order. It is through the legitimacy of difference that new and necessary forms of rationality will emerge and a motivation to engage will occur.

The process whereby the students assist one another as a learning method can be interpreted as one motivating factor that is part of the community of interest, as argued by Wenger-Trayner (2013). This process leads to the socio-cultural approaches to learning in Technology Education.
2.6.6 Socio-cultural approaches to learning

Socio-cultural approaches to learning cover two areas; firstly, the social interactions of learning, and secondly, the position and voices of the participants in the study. In this sense, the type of study undertaken shapes and is shaped by the methodology. Toren (1996) argues that such a study is not the methodology but reflexive of the way of living that is under analysis.

2.6.6.1 The socio-cultural interactions

In this literature review, females are foregrounded in their socio-cultural context in order to analyse the issues they confront and identify with. The research of Zuga (1997) and Wajcman has unlocked the stigma of artefacts and highlighted the sociotechnical constructivist approaches born of but modified from social studies of Technology (Wajcman, 2004). The artefacts Wajcman refers to are those that are gender assigned. That is, products that have become stereotypically relegated to females rather than males. It was the characterisation of Wajcman’s (2004) ‘techno-feminist’ which represented a major development in theorising the gendered character of technology. Cyborg-feminists were coined as a cultural term in social theory by Haraway (in Wajcman, 2004) in a quest to expose the gender blindness of mainstream techno-science studies in order to show the possibilities this area offers women and how they could strategically engage with technology.

This research proposes that the modern socio-cultural liberal feminism and awareness of gender issues can overcome notions of marginalisation (Rothschild, 1988). This awareness enables young women to move past their historic roles in society to achieve equality in learning.

The impact of curriculum on students, whether it is the intended curriculum designed by schools or the unintended curriculum that arises from extra-curricular activities and incidental learning, and students’ socio-economic backgrounds influences what they choose to study in school (Fleer & Jane, 2004). Life experiences and vocational aspirations of students will further contribute to their choice of subjects and potentially their depth of engagement (Pavlova, 2007). These factors influence the socio-cultural experiences of all students and will impact on subject choices they make in school. In this case, student choices are in relation to Technology Education.

Weber and Custer (2005) conclude that both genders entered Technology Education courses with preconceived notions about the types of activities in which they would engage. In this sense, 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 (2005) recommend that there needs to be more research to better understand the dynamics of student preferences for technology-related topics, activities and pedagogical approaches. Williams and Williams (1996) note points of good practice in educating young women in Technology but also the need for a different pedagogical approach.
Pedagogical considerations are also critical to sound gender-balanced curriculum design. Research by researchers such as Brunner (1997), Jacobs & Becker (1997), McIntosh (1983), Rossi (1965), and Zuga (1999) found that there are instructional methods, learning styles, and interests that can be characterized as distinctively female. (Nayler, 1997), in a study of females in Queensland secondary schools, demonstrated the difference in approach for teens. Research undertaken for the National Curriculum in Technologies (ACARA. Australian Curriculum Assessment and Reporting Authority, 2012) provided strategies for junior school engagement that could be utilised by teachers and implemented in the senior schooling area. If the teaching techniques are not appealing to female students, then they will not enter or remain in Technology classes.

2.6.6.2 Positioning the voices in technology

As early as the 1950s and 1960s, writers such as Rothschild (1988) acknowledged the contribution of females to Technology and noted the changing emphasis on whom technology represents and who would benefit from the artefacts and developments of technology. Pupil differences were noted by Kimbell, Stables and Green (1996) in evaluating product tests that showed that the low ability girls almost outperformed the high ability boys. Girls outperform boys when the contexts focused on people (e.g., designing toys for children) but there was a tendency for boys to do better in the industrial context. The context of environments would seem to be largely gender favoured by females due to the social impact on humanity (Pavlova, 2007). Generally, the more open the task, the better the females perform (Pavlova, 2007). Much tighter definitions tend to favour boys. American and British studies (cited in Kimbell et al., 1996) have identified differences between male and female learners but do not examine the causes of gender-biased environments. Kimbell et al. (1996) argue that gender differences are a factor in learning in technology, and hence learning ecologies cannot be neutral.

It is important that research gains an understanding of the dynamics of student preferences for technology-related subjects and pedagogical approaches and topics that are relevant for female students. The second recommendation from the Stables et al. (1996) study is that curriculum developers intensify the use of research results of gender-based studies and that effort be put into developing new resources focused on ethical and social issues consistent with Standards for Technological Literacy (ITEEA, 2012). The authors also argue that demographic preferences should be researched for activities, topics and instructional methods (Stables et al., 1996). It is argued here that investing resources into conceptualizing and developing appropriate curriculum materials for upper level high school Technology Education programs would be particularly important given the growing alliance between school Technology Education programs and engineering, both locally and internationally.
Weber and Custer (2005) suggest there should be further refinement in the use of the Technology topics and Instructional methods Preference (TIP) and Technology Activity Preference (TAP) inventories to assist curriculum designers in developing gender-balanced curricula. Like Weber and Custer (2005) and Mitts (2008) found that fewer females than males were enrolling in Technology Education subjects in the USA. Mitts’ recommendations were that gendered considerations within the technologies domain, using accepted inventories and Standards developed through the TfAA project and criteria, could assist in identifying what is seen as good practice in Technology classrooms that engage females.

The International Technology Education Association (ITEEA, 1994) launched its TfAA project in 1994, in answer to the growing number of voices world-wide that were calling for the mandatory study of Technology by school-aged children. The project and its outcomes were seen as a means through which future generations could become technologically literate citizens (Dugger, 1997). In doing so everyone was to have a voice within technology.

2.6.6.3 How different genders learn

Smith and Lloyd’s study (Paechter, 1998) concerned 32 five- to 10-month-old babies and their mothers. The babies’ names were represented on the clothing they were dressed in, but not necessarily reflective of their gender. It was found the mothers interacted with the girls and boys differently. In terms of toys, only ‘girls’ were offered dolls initially, while boys were given more verbal encouragement to crawl, walk and engage in large-scale physical action. The gross motor behaviour of the infant was responded to according to the perceived sex of the infant. Gender assignment leads parents and others to modify their behaviour to a child, from infancy, according to their sex, causing the gender role, responses and life experiences to develop in certain ways. Over time, gender stereotypical roles are reinforced and policed by children themselves (Paechter, 1998). Paechter (1998) argues that these non-physical gender differences are translated into mutually exclusive gender roles in Western societies. Furthermore, Talbot (2010) says we are shaped by discourses and as gender is performative, we take on the stylisation of that image. It may follow that students are nurtured according to the long-held familial and social beliefs and the artefacts they live with.

Artefacts shaped by gender relations have meanings and identity. The exploration of the hierarchy of sexual difference affects the design, development, diffusion and use of technologies. Bijker (1995) wrote of the gendered artefacts and the nature of sociological change, which built on his previous work with Hughes (Bijker & Hughes, 1989) that saw Technology as a reflection of society and therefore requiring a constructivist approach. Stanley (1983; 1993) developed the notion of gender and functionality within Technology; while Spender (1980), in analysing the power and control of language as against the artefacts and function of Stanley’s work, claims that it is this gendered nature of control that is shaping
Belenky, Clinchy, Goldberger and Tarule (1986) question the power and authority elements of women in society. The authors argue that in the present system of projects, only certain students will grow beyond their dependence on the existing social structures and norms that are articulated in a male-dominated society. The five perspectives from which females perceive truth and knowledge (including, silence, received knowledge, subjective knowledge, procedural knowledge and constructed knowledge) need to be understood in order for females to strive towards self-realization (Belenky et al., 1986). The interests of female learning are not necessarily vested in formal education (Tarule, 1989).

Belenky et al.’s (1986) research leads to the question of what may be the difference in how different genders learn. Dominance theory does not solve the issue of gender difference. Danilova and Pudlowski (2010) argue 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. Eckert & McConnell (2003) talk of the performance turn of language in constructing gendered identities and norms.

In a study of teenage students, Persson (2010) argues that, when appealing to them, we need to acknowledge that issues of gender, design and culture exist. These issues should mould what values are placed on artefacts students wish to work with and relate to.

Wajcman argues 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 socio-material product – a seamless web or network combining artefacts, people, organizations, cultural meanings and knowledge. (Wajcman, 2004, p. 106)

By drawing upon the work of earlier writers who have informed the direction for this thesis which takes into account what Graube and Theuerkauf (2003) refer to, in technological acting competence, as a reflection of real life, encourage individuals to deal with technological problems in an open school environment. By altering the social and individual conditions for learning, students will be enabled to access, via thinking processes, practices that have not been achieved in the last century. This can occur on a theoretical and practical level moulded to the classroom investigation of this study. Middleton (2008, 2009) notes that research in Technology Education is relatively recent and that new research methods and techniques have looked at techniques for examining concept formation, comparisons and contextual knowledge and higher order processing skills.

Agency remains to be uncovered through feminist philosophies and feminist orientations for research. This thesis provides a reconceptualization of agency for learners and teachers. Feminist research can do three things. Firstly, it can displace traditional knowledge in favour of particular situated practices of knowing in action. Secondly, it can direct attention to
the ongoing aspects of sociotechnical assemblages and the capacities for action they enable. Thirdly, it can orient us to relations and symmetries among personas and things and to the politics of difference (Suchman, 2007).

2.6.6.4 Socio-cultural underpinnings

The critiques of feminist writers range from the postmodernist feminists, the Marxist feminists to the postmodern liberal feminists’ views discussed earlier. While all seek to unmask social issues, writers of the radical and the Marxian schools seek to investigate from a negative/subjective point of view (Wajcman, 2004). Such a view claims all women are oppressed and, hence, are in need of rescue. This study, however, takes a positivist perspective to Technology Education through an ethnographic methodology that aims to unearth the voices of females. This is explored and addressed further in the methodology section in Chapter 4.

This thesis examines the possibility that it is the modern socio-cultural liberal feminism and awareness of gender issues that will unlock the possibilities for modern day females. Addressing gender issues will enable young women to move past their historic roles in society to achieve some degree of equality in learning.

An ethnographic case study was used in the case studies to unpack learning and technology approaches within Technology Education classrooms. This approach addresses the second of the research questions. Merriam (1998) describes learning in socio-cultural theory as distributed, interactive, and contextual and the result of a learner’s participation in a community of practice. Pintrich and Schunk (2002) argue that the collaboration of thinking that results from these processes opens up access to direct data on thought processes and provides avenues to uncover more concepts.

Belenky, Clinchy, Goldberger, and Tarule, (1986) speak of the silence of women and the need to listen to the voices of constructivist women in order to alter the social landscape. Hoepfl (1997), in examining research paradigms focussing on the use of qualitative methodology, argues for the responsible implementation of the research and a plausible connection between the observations and the conclusions drawn. Socio-culturalism thus provides the platform for research.

Socio-constructivism is an open-ended process where knowledge is constructed through the interplay of existing knowledge and the individual’s social experience (Kim, 2001). As a theory, it has been used in relation to pedagogic strategies and instructional design models, which, as a learning theory, emphasizes the impact of collaboration and negotiation on thinking and learning, along with assisted learning. It is concept is influenced by socio-culturalism, with society playing a developmental role for the individual and the teacher acts as the scaffold of learning (Johnson, 2002; Vygotsky, 1978). This is distinct from the Piagetian view that individual knowledge relies on the social construction of it (Doise & Mugny, 1984; Piaget,
1995). Learning is a communication process via the interactions an individual has with those around them. Learning designs should be about local collaboration, and the interactions to learn lie with the domain experts. Collaboration is the key in the learning process.

The constructivist theory of socio-technical change examining the symmetry of socio-technology concludes that all is relative to the social group at hand and that we interpret artefacts, their use and sustainability through invention and social interactions of social groups (Bijker, 1995). This social-constructivist model shows that technical development is contingent on choice, contextual constraints and alliances and the process of social construction has a dual character. All work falls into the categories of scientific, technical, social or economic. Bijker’s work aligns with the models of technological literacy outlined earlier.

Social constructionism stemming from the Vygotskian notion of activity theory is a social phenomenon (John-Steiner & Mahn, 1996). It is a social concept or practice that is the construct (artefact) of a particular group. This social construction of reality which stems from humans as social beings is an ongoing and dynamic process where people act on their interpretation and knowledge of reality. Social constructs are not those given by nature but ones that must be constantly maintained and re-affirmed in order for them to persist. To bring about change takes processes and effective action.

Pintrich and Schunk (2002), in reviewing socio-cultural influences on youth in education, look to theoretical backgrounds such as modelling and behaviour, goals and achievement motivation, peer networks and familial influences all of which impact on student learning in context of schools. Merriam (1998) applied the thought processes and collaborative thinking to females in classes. Toft’s (2007) research found that there may be some difference in the functionality of the brains of females and males.

Of relevance to this thesis is the origin of social constructionism in the post-modernist movement and the claims that gender is socially constructed. The research of Brizenidine (2006) serves to dispute some of these claims but does support the argument that we do need to cater to the learning styles and functionality of females differently to those of male students. Indeed, we need to take into account the cognitive and affective aspects of learning as well as the creative aspects (Knopke, 2012).

Postmodern theorists such as Foucault (1980) have helped to explain how knowledge that is legitimized by society sustains the power of the dominant group and reproduces unequal relations. These unequal relationships ultimately cause social strife. Other writers would claim that Foucault was concerned with the domination of science without consideration of external factors. The path taken by Technology educators currently needs to be investigated in terms of the reproduction of unequal relations and the dominance of powerful groups. The postmodern philosopher Wright argues that:
In order to prepare for the future, Technology educators must seek alternative ways to conceptualize their subject matter to reach the diverse population of citizens in this society. They must rethink the way in which they legitimize the knowledge of Technology Education for students in order to meet their needs and wants. (Wright, 1992, p. 212)

Wright (1992) states that the social commitment must be to legitimise the principle of difference through a knowledge of diversity and professional language. “It is through the legitimacy of difference that new and necessary forms of rationality will emerge” (1992, p. 212).

As with postmodernist theories such as Wright's (1992), feminist theories also encourage diversity in their view. Feminist theories encourage us to tolerate and interpret ambivalence, ambiguity, and multiplicity as well as to expose the roots of our needs for imposing order and structure no matter how arbitrary and oppressive these needs may be. If we do our work well, reality will appear even more unstable, complex, and disorderly than it does now (Flax, 1990). Both postmodern and feminist theories point to diversity as a direction for the future and can provide some of the ideology for Technology educators, avoiding a restricted cultural view and creating change in the profession (Zuga, 1996). As Hacking articulates, “A social notion cannot be brought in to fill a rationalist gap” (1999, p. 31).

Hacking (1999) argues that rationality itself is constitutively social. Thus, the use of 'social construction' has been for raising consciousness. Individuals must perceive the world as socially constructed because beliefs and social values are intertwined. The underlying approach of these arguments, according to Durack (1997), is to raise the consciousness of gender and the feminist uses of the construction of ideas. Biological differences between sexes do not determine gender, gender attributes, or gender relations. Gender, in this conception, is a constitutive social construction (Durack, 1997) a social category whose definition makes reference to broad network of social relations, not anatomical differences (Haslanger 1995; Durack, 1997).

This social-constructivist perspective aligns well with the social manner in which Technology is developed through design teams that support collaborative classroom environments in Technology Education. These factors are what earlier research (Biljker, 1995) claims is the way females prefer to learn. The question here is the relevance of these factors in the context of 2015 Technology Education in Queensland senior schooling.

The final area of research is that of values. Pavlova and Turner’s research (2007) has addressed notions of values in terms of sustainability and access. It is the issue of values which underlies the feminist perspective and how these translate into education at the local level which relate to this study. Eco-feminism has not been adopted as a critique but is examined further in terms of its conceptual realisation (Lerman et al., 2003).
2.6.7 Values within Technology Education

Values are examined from two aspects; firstly, values and Technology Education, and secondly, values and motivation.

In the modern world, it has become virtually impossible to disentangle Technology, in its variety of forms, from ethical implications. Ethics and values shape and drive demand for new technologies. New technologies, in turn, mirror and reflect what we value; the two have become inextricably woven together (Custer, 2007).

Values have been examined within Technology Education research; however, they appear to be treated as gender neutral. Pavlova’s (1999) research addressed notions of values in terms of sustainability and access but it is the issue of personal values that underlie the feminist perspective and how these translate into education at the local level that relate to this study. Eco-feminism has not been adopted as a critique to be examined further in terms of its conceptual realisation, because of its alignment to the Marxian feminist movements.

Rokeach (1973) argues that values underpin the explorations and the definitions that have endured over time and applicability across contexts of learning and human endeavour. Rokeach (1973) argues that there are terminal and instrumental values, both of which are relevant when considering the types of behaviour observed in classrooms. Terminal values, such as ambition, self-control, capability, imagination and independence, can be identified by participants. Instrumental values are the idealised modes of behaviour concerned what are perceived to be instrumental to the attainment of desired end goals (Rokeach, 1973). Pavlova (2009) examined the critical issue of values in Technology Education, finding that education for sustainability in Technology through values should be a key component of content learning. Custer (2007) concluded that values and Technology are intimately connected and interwoven.

Technology is a human activity requiring a complex understanding of technology, human activity and cultural values that extend beyond the science and engineering of how things work. The TfAA Project (Dugger, 1997) saw the underpinning of Technology Education as having an ethical and values based understanding. Technological literacy and goals as noted by Ritz (2009) contribute. Values in the broad sense of ethical behaviour are those embedded in the Melbourne Declaration as part of the National values for schooling in Australia (National Values, 2004), as outlined in Chapter 1.

Further research by Pavlova and Turner (2007) demonstrates that through sustainable development (SD) learning, activities could take place on the basis of conceptualisations of education for sustainable development that established that cognitive, moral and practical bases for learning and these should be considered during the planning process (Pavlova & Turner, 2007, Pavlova, 2009). Teaching programs do not overtly cater for gender specific values.
Therefore some attention will return to the thesis of Wajcman (2004) and Belenky et al. (1986) in examining values that appeal to one gender.

Fleer and Jane (2004) and Fleer and Hardy (2001) found that values related to young children in Technology appear in the research about the social shaping of Technology but fail to address gender issues when addressing good classroom practice in later school contexts. These contexts are the setting for the study in this thesis.

The New Zealand Ministry has explored and implemented the concept of values into their national curriculum (Lee, 2011). Technology Education is seen as both values laden and values dependant. With technological literacy at the heart of their programs, it is identified as a natural way to embed technological learning and values education. Embedding of values is done from a nationalistic sense through capability development in line with the New Zealand curriculum. Comparing New Zealand and six other countries, Lee (2011) provides a definition of technology, relates it to culture and the use of technology, and demonstrates why historical, societal, cultural and environmental emphasis should be put into the curriculum ahead of designing and making processes. Lee’s research focuses on the products and social context but does not delve deeper into the gender implications that could be the core component of the artefact discussion when discussing gender-stereotyped products.

In looking at the political agenda, Lewis, Mansfield and Baudains (2008) examine the steps that set the discourse of putting resources toward the development of national values in line with international standards. Their research examines the factors that shaped the values of Australian schooling. These values are: care and compassion; doing your best; fair go; freedom; honesty and trustworthiness; integrity; respect; responsibility; understanding, tolerance and inclusion (Lovat & Toomey, 2009). Middleton (2008) examines the types of capabilities that are evident in context for the Australian curriculum. Lovat and Toomey (2009), Wiggins and McTighe (2005) have looked at examples in context and the nature of understanding and its doorways (the openings that values provide for participants) and consequent meanings. These capabilities and core values initiated the examination throughout the review of values literature.

Pavlova (2009) examines sustainability within a values perspective in both research and practice while providing international comparisons of developments. Hoepfl’s (2013) examinations of appropriate Technology and Middleton’s (2005) research on values design and creative thinking provided a basis for investigation in the observation phases, while Fuller (2008) argues that we need to be “in the business of sparking minds and igniting passions in young people”. Adolescents are ready to solve the big questions of life. Research around mathematics in early adolescents has shown that studying this area can accelerate learning for all adolescents. Not only do the highly capable improve dramatically, but so do the mathematically less able. Fuller (2008) claims that too many female students are receiving a strong message from schools, and that message is that mathematics is not for them. Hence, they
are being streamed out. The lesson here is not only acceleration for all but in extending the view to one that encompasses disciplines such as Technology Education that rely on the underlying principles of mathematics.

In examining the literature on what motivates youth, values are explored in the context of educational settings of secondary school students, with a focus on motivation in Technology Education.

2.6.7.1 Motivation through values

Values, argues Rokeach (1973), have a motivational function to guide human activity in daily situations, with their more long-range function to give expression to basic human needs. Values’ components include motivational, cognitive, affective and behavioural elements. Instrumental values are motivating because of the attainment of desired end goals while terminal values are motivating because they represent goals beyond the immediate, biologically urgent goals. They are the conceptual tools that we employ to maintain and enhance self-esteem (Rokeach, 1973).

Terminal and instrumental values are relevant when considering types of behaviour students engage in in classrooms. Rothschild's (1988) terminal values point to the end result somewhat aligned to the Linnenbrink and Pintrich’s (2002) and Pintrich and Schunk’s (2002) notions of mastery and performance. If performance is the terminal point, then it may not contain the intrinsic motivational factors of learning to master the skills within the task. Pavlova’s (2009) work on values in Technology Education in relation to sustainability has further shaped this study in the need for ongoing sustainability and recognition of the enactment of values in relation to Technology.

Values that are internalised as a result of cultural, societal, and personal experience are psychological structures that, in turn, have consequences of their own (Rokeach, 1973). Values are determinants of all kinds of social behaviour – of social action, attitudes and ideology, evaluations, moral judgements and justification, comparisons and presentations of self and others, and attempts to influence others. Klapwijk and Rommes (2009) note values in their use of the phrase ‘career anchors’.

According to Pavlova (2005), a person’s actions may then vary depending on the priorities they place on social and personal values. Their actions will vary depending on whether their social or personal values have priority. An increase in one value may see a decrease in the opposite, e.g., social or personal. Personal values arise from participants in relation to their learning within Technology classrooms and about artefacts that students interact with on a daily basis. Terms such as personal and social ambition, self-control, capability, imagination and independence can be identified by participants in terms of which aspect motivates them to succeed. Pavlova & Turner (2007) have examined the critical issue of values in Technology
Chapter 2. Literature Review

Education and discuss the design process as a starting point for internal and external values. Custer (2007) argues that values and Technology are intimately connected.

A value system is thus defined as an enduring organisation of beliefs concerning preferable modes of conduct or end states of existence, which sit along a continuum of relative importance (Rokeach, 1973). Values, like all beliefs, have cognitive, affective and behavioural components. Each of the aspects of values, sustainability (Pavlova, 2009), internal and external views (Pintrich & Schrunk, 1986), instrumental and terminal states (Rokeach, 1973) as well appropriate Technology of Hoepfl (2013), are relevant to the observations that were made as part of this research study.

The research literature outlined above shows that there is a need for contemporary investigations into gender in Technology Education. Given that students, their attitudes and expectations have altered, there is a need to analyse current practices and the outcomes of current practice between schools, teachers and students. This helps shape the methodology outlined in Chapter 4 and the results and data analysis presented in Chapters 5, 6 and 7.

2.7 Review of the themes

This research is timely given the implementation of the National Curriculum for Technologies in Australia. School systems, administrators, heads of department and teachers are hoping that, in the long term, there will be a positive flow on of females from the primary and junior school areas ready to engage in Technology.

The literature review shows that there is a need for this study. It is consistent with Zuga’s (1996) argument there is a need for feminists to challenge the past and the existing political education system that currently exists in order to provide a path forward that is encompassing for all groups. The calls for the reclaiming the voices of female educators in Technology have come full cycle (Zuga, 1996).

This review of literature related to strategies that may encourage females to engage in Technology classes has illustrated that a heightened awareness of the educational and environmental aspects that cater to a specific gender will have flow on effects, and may mean that more female students enter tertiary courses in STEM. Engineering and the STEM subjects will ultimately benefit as a discipline.

This review has found that there is an urgent need for feminist agency to be located within Technology Education, given the lack of recent research in the field in Australia. This will enable teaching and learning developments to be enhanced, in order to make Technology Education more relevant and attractive for all students.

According to the research questions, there needs to be a focus of topics, in context, unique to Technology Education for females. The areas that were reviewed in this chapter were
the ecology of classrooms, gender and technology, language, motivation, role modelling and peer support, socio-cultural approaches to learning, and values. This research looks to uncover the issues discussed with regard to female’s voices and attitudes in order to signpost a way forward.

Martin (2008) found that females will take up technology-related subjects if there are overt programs to encourage them into the fields but the long-term sustainability of such programs have not been guaranteed. One possible conclusion to be drawn from the research literature is that if females are given a longer-term engagement in Technology Education through primary and middle school years, then they may not be as hesitant to engage with Technology in their senior secondary years.

Attitudes and values serve to heighten the division between females and males in not only Technology Education classes but also other subjects, such as science, during the senior years of schooling. These attitudes are often held by parents, students, and teachers. Perhaps it is the social and cultural norms that are the factors which include or exclude females from Technology Education classes. Teaching and learning in Technology Education should be more accommodating to the values that females hold. Different learning styles do address the issues of females needs as against the needs of male’s learning in education. As outlined above, there is a sufficient body of educational research to uphold the difference in learning styles and how female learners can be catered to (Fleer & Jane, 2004; Murphy, 2007). This thesis suggests that Technology teachers and educators not only acknowledge the difference but also make overt allowances for gendered differences in their programs and their teaching.

The final point suggests that teenagers in 2015, the senior secondary participants in this study, are more likely to undertake a technology-related subject if they have a role model figure or peer group to engage with in that setting. Thus, the social factor could be an important factor in this field.

Potential ways forward to broaden participation in the field of Technology will be provided in the results of the research study. In adopting a feminist ethnographic perspective, the research will foreground feminist voices, issues, and methodologies.

The following chapter outlines the theoretical framework and the concepts which underpin the study.
Chapter 3
Theoretical Framework

The purpose of this chapter is to present the theoretical framework which underpins the thesis. After outlining the research questions and the conceptual underpinning of the study, it will examine the definitions that are adopted throughout the thesis. Each of the themes which were used for the case study analysis are examined in detail and summarised in the methodology chapter. The themes emerged from the review of literature related to Technology Education. The seven themes are related to the Australian post-secondary school education. This area has not been researched in depth in Australia. The central question examines the factors which facilitate and encourage the meaningful engagement of females in Technology Education classrooms and thus increase the participation rates in the long term.

The content of this chapter has been grouped according to the seven themes developed through the literature review Chapter 2. These themes are: the ecology of learning, gender and Technology Education, language use in classrooms, motivation, role modelling and peer support; socio-cultural approaches to learning and finally values. The research questions begin the chapter, followed by the definitions of the key terms which will be used. Subsequently, background knowledge on the study is provided, and this is followed by an evaluation of feminist critiques and why the specific focus was chosen ahead of other feminist interpretations. A description of each of the seven themes that will be used in the analysis chapters is then provided, and the chapter concludes by summarising the three frameworks used, the reasons they were chosen, and how they will shape the methodology chapter and the subsequent results and analysis chapters.

3.1 The research question

The research question asks - what factors encourage and facilitate female student’s to participate and engage in Technology Education?

3.1.1 Three questions

Three questions underpin this study. The first question asked - what factors have influenced female student’s choices to take a Technology Education class as part of their senior school learning pathway? The second question asks - how teaching and learning was conducted and approached in Technology Education classrooms? The final question examines - what values are addressed through the teaching and learning in the specific contexts of the Technology
Education classes and the teaching programs and how can positive and dynamic technology environments be identified in co-educational classrooms?

These questions emerged from the literature review that identified a need for gender studies in Technology Education in the Australian context. The other important starting point is issues associated with gender parity. The current research shows that there are gaps in educator’s knowledge of the social structures as a device for gender positioning in Technology related subjects. Studies have been done in Europe and the United States of America, however, the context of Australia and the use of an ethnographic case study methodology in relation to gender and Technology Education makes this study unique.

Whilst the topic relates to gender and technology the literature review presented evidence related to the theme of gender engagement in Technology Education. This theme as outlined below has been labelled gender and Technology Education.

In developing an internally coherent theoretical framework a number of theories and theoretical frameworks were used as models. Each of the concepts relate back to the research questions and gaps in the research literature. This chapter examines how each of the themes relates to the data collected for this thesis. The research questions are in turn translated into a theoretical framework that serves this thesis.

The following concepts have been considered when examining the theory behind learning in Technology and the themes that have been adopted to build the framework for this study. The literature examined: feminist critiques, education and pedagogy, learning ecologies, the principles of effective teaching and learning and lastly values in Technology Education.

### 3.2 Definitions

#### 3.2.1 Technology

This concept has been addressed in the earlier chapters and is applied in context.

### 3.3 Technology Education

Technology Education encompasses all subjects which have a design process as the key learning activity. In the Australian context, subjects such as Agriculture, Business Studies, Industrial arts and design, Graphics, Home economics, Hospitality, Information and Communication Studies, Technology Studies, Engineering Studies, fall into this definition. Whilst there is currently much debate surrounding the term it links to past and present senior syllabus practices in the Australian education system. This study focuses on the subjects which historically fall under Industrial Arts; i.e. Technology Studies, Engineering Studies and Technology and Design.
3.3.1 Gender and Technology-the broad view

Studies related to gender and Technology Education have been undertaken in Europe and the United States of America as detailed in Chapter 2. There is a need, however, in the context of Australian education for an ethnographic case study methodology in relation to gender and Technology Education. If educators and industry are to move forward with the objective of raising gender targets/quotas in Technology subjects in secondary schools then the issues raised in this thesis need to be considered. The flow on effect is into universities in the STEM subjects and into industry in order to address the underrepresentation of female participants.

Researchers such as Williams and Williams (1996) have identified the need for specific research in areas of Technology Education.

There is one feature in Technology Education which is worldwide: Technology Education attracts fewer girls than boys… girls find Technology less interesting than boys, and they see themselves in less technical jobs…” (298). They claim then that girls are interested in other topics, in other kinds of activities. They feel more insecure, they need a different pedagogical approach, a different classroom climate… teachers should be aware of these problems of girls in Technology and should: be aware of gender stereotypes and avoid them. (Williams & Williams, 1996, pp. 298-299)

Williams and Williams’ statement is symptomatic of the era and leaves the issue as one yet to be addressed. Subsequent research has not claimed to solve the issue of female participation.

Gender equality is a global priority for UNESCO and is inextricably linked to UNESCO’s efforts to promote the right to education and support the achievement of the Education for All (EFA) and broader development goals. The organisation aims to promote gender equality through education systems.

Gender inequality in education according to UNESCO takes many forms depending on the context. Though gender inequality affects girls and boys, women and men alike, girls and women are still more often disadvantaged. Such discrimination in education is both a cause and a consequence of broader forms of gender inequality in society.

UNESCO Education encourages the mainstreaming gender equality issues in education at all levels; from early childhood to higher education, in all settings; from formal, non-formal and informal, and in all intervention areas; from planning infrastructure to training teachers in order to address what is seen as a global issue (UNESCO, 2014).

The following provides definitions which have been applied throughout the study.

3.3.1.1 Feminist theory as expressed by Hesse-Biber (2010, p. 151) considers “women’s everyday experiences while analysing the gaps that can occur when women work to fit themselves into the general culture’s way of understanding women’s positionality”.
3.3.1.2 Feminist empiricists are the feminist researchers of 70s & 80s who worked within positivist tradition to ‘deconstruct’ what they perceived as errors within their disciplines, to eradicate sexist research, and to include women’s concerns in research endeavours (Spender, 1980).

3.3.1.3 Feminist objectivity: a type of objectivity in which knowledge and truth are considered partial, situated, subjective, power imbued and relational (Hesse-Biber, 2010).

The definitions and interpretations help to identify issues relevant to classroom environments and will provide additional insights into current practices in Technology Education. The current research shows that there are gaps in knowledge of social structures of knowledge as a device for gender positioning in Technology Education subjects.

3.3.2 Gender and Technology – the research view

There is a body of literature on gender and Technology from the mid twentieth century (Lerman Mahun, & Oldenziel, 2003). However, there have been few in-depth studies into gender and values in Technology Education completed in recent decades and fewer studies in the secondary school domain. Whilst there has been much written about females in education and Technology historically (Stanley, 1992; 1993) and the sociological relationship of women to Technology (Lerman, et al., 2003) there has been a general absence of research in the area of female preferences for learning and particularly in relation to Technology Education. Lerman, Mohun and Oldenziel (2003) suggest that any research has been fragmented or at times relegated to the ‘black box’ (Crilly, 2010). In referring to the ‘black box’, Lerman et al. mean that recorded data is only viewed in times of extreme emergencies. They cite the sluggishness of historians of Technology to heed research into masculinity as a cultural dimension of traditional technology. In the context of 2010’s there have been calls for gender research but few actual in-depth studies have been undertaken. Williams (2011) argues that the move to a more sociological view which considers the cultural context and interactions between people will impact on future research in Technology Education.

Previous studies in Technology Education and gender can be grouped into a number of headings: Actors and ages of the studies and the participants (Wajcman, 2000), micro studies within classes as to what students wished to study (Weber & Custer, 2005), teaching and learning, pedagogic issues (Rothschild, 1988), gender awareness (Wajcman, 2000), teacher allocated time and engagement (Williams, 2011), and, finally, technological literacy and engagement for process in Technology (ITEA, 2004; Williams, 2011).

The groupings demonstrate the studies that have provided the most influence in Technology Education with regard to females in the subject area from the authors listed. Whilst there is an aspect of gender awareness led by Wajcman (2004) and Zuga (2007), many of the other studies which have touched the gender issue are not empirical research.
Chapter 3. Theoretical Framework

There is research which strengthens the male/female divide in learning. Martin (2008) found the females will take up Technology related subjects if “there are overt programs to encourage them into the fields but the long term sustainability of such programs have not been guaranteed” (p. 24). “Historically the short term results of such initiatives have not translated into long term gains” (p. 24). One possible conclusion to be drawn from the research literature is that if females are given a longer-term engagement in Technology Education through primary and middle school years then there may not be the hesitancy to engage with Technology in the senior secondary years.

Attitudes and values serve to heighten the division between females and males in not only Technology Education classes but other subjects, such as science, during the senior years of schooling. These attitudes are often held by parents, students and teachers (Russell, 2014). Are certain social and cultural norms, factors in including or excluding females from Technology Education classes? Teaching and learning in Technology Education should be more accommodating to the values that females hold. This can be accomplished through the use of differentiated instruction as a philosophy of education that seeks to create meaningful educational experiences (Hoepfl, 2007). Differentiated learning styles do address the issues of females needs as against the needs of male’s education (Tomlinson, 2001). There is sufficient body of educational research both in Australia and overseas to uphold the view that there is a difference in learning styles and how each can be catered to (Dow, 2007; Fleer & Jane, 2004). Our Technology educators need to not only acknowledge difference but make overt allowances for these differences in their programs and their teaching.

The evidence would suggest that students who were in their teens in 2012 - 2014, and were the senior secondary participants in this study, are more likely to undertake a Technology related subject if they have a peer group to engage with in that setting and a motivational driver.

3.3.3 Gender and Technology the Australian context

The recognition of equity concerns for learners in Australian education has been cyclical. Given the liberalisation of education which encompassed females in the 1960s as had never been achieved before, inroads were to promote females in education. Females completed higher levels of secondary schooling which has continued over the following decades albeit in traditional classes of secretarial/business studies, home economics and social science disciplines (Teese & Polesel, 2003).

The 1970s saw the burgeoning of studies examining women, gender and Technology in the United States. Lerman et al. (2003) suggests that there were two streams, one the feminist sociologists of technology who examined the relationship between gender and Technology. This was often ethnographic work examining patterns of technological change that are fast paced. The second stream examined gender within an historical context. Rothschild (1988) offered a
critique of the status quo suggesting that women’s values might be embodied in the designs of dominant technologies. Rothschild’s work critically challenged thinking in technology by arguing the focus needed to be not on what men do but on what people do while altering views on what technology itself was.

The decade of the 1980s saw Australian research commissioned by the Advisory Council to the Minister for Employment and Industrial Relations in Australia (MEECTYA). Byrne (1985) examined the under representation of women in engineering and engineering studies identifying a number of barriers which included entry to tertiary institutions and perceptions of these studies, career education and role models.

The broadening of Technology Education in the 1990s brought research and academic standing to the issues of gender and technology. Zuga (1996) identified that studying Technology was not just for the content but for the value of the area itself (Lewis, 1999). In the same decade, gender, cognitive and cultural backgrounds of learners in Technology was foreshadowed as a burgeoning area which was to be embraced within Technology (Williams & Williams, 1996).

3.3.4 The Feminist Critique

Researchers of 1970s and 1980s, the feminist empiricists worked within the positivist tradition to ‘deconstruct’ what they perceived as errors within their disciplines. Their objective of eradicating sexist research was to include women’s concerns in research endeavours (Lerman et al., 2003).

Feminist objectivity can be described as objectivity in which knowledge and truth are considered partial, situated, subjective, power imbued and relational. The concern with any feminist perspective of the social world is to create a more socially just world (Hesse-Biber 2010, p. 128). Feminist research aims to capture the subtleties and nuances of women’s lived experiences.

Feminist research can do three things. Firstly, displace traditional knowledge in favour of particular situated practices of knowing in action. Secondly, it directs attention to the ongoing aspects of sociotechnical assemblages and the capacities for action they enable. Thirdly, it orients us to relations and symmetries among people and things and to the politics of difference (Suchman, 2003, p. 6).

Narrow oppositional constructions of masculinity and femininity as termed by writers such as Connell (1995), Martino and Pallotta-Charolli (2003) felt that the lack of critical guidance in education policy has enabled stereotypical gender roles and behaviours to embed themselves in our schools (Ollis, 2011). A similar tendency is observed by and illustrated in the arguments of Keddie (2009).
A decade into the new millennium, concern for gender justice has been reconstructed in Australia. Delany writing in 2012 claims that neoliberal economic rationalism has shifted the focus of schooling to the ‘production of future workers’ (Connell et al., 2009, p. 335; Delaney, 2012). Concerns about academic outcomes, client ‘choice’, and competition have further sidelined issues of social justice and pedagogy. Public culture and education reforms have come to reflect, without critical view, the dominant state ideology. Equity has become mostly underpinned by mere rhetoric of democratisation (Blackmore, 2011). Equity and diversity discourses have been appropriated into institutional objectives which align with neoliberal discourses about individual choice and sidestep attention to systemic and cultural factors (Davies, 2003; Blackmore 2011). A range of simplistic, gender-neutral, antifeminist and essentialist discourses and understandings about gender dominates, and drives school curriculum and pedagogy (Lingard, Mills & Bahr 2002; Martino, Lingard, & Mills, 2004; Martino & Pallotta-Chiarolli, 2003; Keddie, 2006). Approaches which have been criticised as promoting narrow and oppositional constructions of masculinity and femininity, are serving to constrain gender justice (Connell, 2000; Keddie & Mills, 2007).

In order to bring about change Blackmore (2006) argues there is a need for;

- democratic de-liberalisation asserting that feminist policy work is a situated, social and collective practice undertaken by different people, informally and formally, differently in different contexts. Such change must be grounded in process and brought about by dialogue at many levels. (Blackmore, 2006, pp. 194 -196)

There is a body of academia that suggests that equity committees are now paying lip-service to the notion of inclusion and serving to maintain a long held tradition of the status quo.

...equity programs which simply introduce the idea of equity, and which rely on role models and access to non-sexist curricula, will not be enough to disrupt these strongly held theories of gender and patterns of desire. (Davies & Banks 1992, p. 23)

Fraser (2007) argues the need for feminist politics to be situated two dimensionally between the struggle for labour-centred problematic social feminism and the culture–centred, ‘post-Marxian’ strands of gender theorising. The first of the strands is about distribution whilst the second is centred on recognition, identity and representation of gender in what Fraser terms a ‘networked society of neoliberalism’.

In summary, feminist research takes account of the feminist voices. It is the searching for feminist presence, followed by female voices which influenced the ethnographic case study methodology that has been used within the study in the context of socio-cultural research. The themes, as outlined below will be used.
3.4 Description of the themes for case study analysis

The following outlines the themes that developed and through which the study is analysed. Further detail is provided in Chapter 4, which discusses the methodology of this study.

3.4.1 Learning ecology

Siemen’s (2006) definition of a learning ecology as defined in Chapter 2 fosters and supports the creation of a knowledge sharing, learning community. Brunner and Bennett (1997, p. 47) outlined seven elements: – “flexibility; tool-rich; consistency and adequate time; trust; simplicity; learning is decentralised, fostered and connected; and there is a high tolerance for experimentation and failure”.

A reason for examining the ecology of a classroom is that it may show the inclusiveness of the activities and interactions within the learning environment (King, 2003). King argues inclusion is an attitude, a value and a belief system. When focusing on learner outcomes teachers need to vary instruction, curriculum, and assessment practices to meet the range of developmental and educational needs present in today’s classrooms. To be inclusive is to consider and cater for the marginalised groups based on sex, race and religion.

King (2003) proposes five general dimensions that give an integrated perspective on classroom factors that influence learning. These include: The learner’s knowledge base; motivation and affect; development; individual differences; and the context. This study has extended on the dimensions and listed seven themes. Many of the themes are interwoven and at times difficult to separate.

3.4.2 Gender and Technology Education

Gender and Technology Education encompasses the social constructionist feminist perspective utilised in this study. The work is foregrounded by that of Zuga (1997) and Wajcman (2004) in the techno-feminist characterisation of technology. Their work in exposing the cultural blindness of techno-science studies showed the possibilities that this area offered to women and how they could strategically engage and participate in STEM studies. The empirical work of Belenky, Clinchy, Goldberger and Tarule (1986) looked to find the voices of women that we continue to seek today.

3.4.3 Language use in classrooms

Language use in classrooms was investigated through Spender’s (1985) research which argued that men control language which in turn ensures opportunities from a power perspective. Language is as much written, spoken, gestured and positional discourse. Language was analysed in terms of control and conveyance of the messages related to Technology. This work was updated by Eckert and McConnell-Ginet (2003) and that of Talbot (2010).
3.4.4 Gender and language
The concept of language and gender as expressed by Spender (1985) is pivotal in this investigation. Challenging the cultural norm of language and how teachers address students and their subject area may illustrate some underlying cultural assumptions. The frequent theme of the masculine language of invention of Oldenzel (1997) and Biljker et al., (1995) may explain why females do not readily participate in this learning area. It may be that language conveying the essence of the subject provides a message to females in schools which they use to form an opinion of the subject and its applicability to them.

Technology Education curriculum, as language about Technology that is intended for all students, needs to incorporate the diversity of people, positions, and values in order to reach students and to serve as a socially valued subject in the school curriculum (Zuga, 1996). Technological literacy, and its links to language, values and understanding, provides the criteria and links to teasing out the actions in classrooms and school setting

The second aspect to language is the question of when opinions are formed by females about what they will study. Are their opinions formed via the language used or via social expectations? Ford (2011) suggests that it is during the early years of education that these decisions are made. Is it the curriculum enactment which shapes the engagement of females in the subject? In examining the data from female participation and performance in Technology Education subjects it is evident that less than ten per cent of enrolments are females but those females who do enter the classes achieve higher level results than their male counterparts, in many instances (QSA, 2012). Factors in this subset will be analysed through the interviews with participants.

3.4.5 Motivation
Motivation is defined as the process whereby goal- directed activity is instigated and sustained (Pintrich & Schunk, 2002). Values, argues Rokeach have a motivational function: to guide human activity in daily situations, their more long-range function is to give expression to basic human needs. Values’ components include motivational, cognitive, affective and behavioural elements. Instrumental values are motivating because the idealised modes of behaviour they are concerned with are perceived to be instrumental to the attainment of desired end goals. Terminal values are motivating because they represent goals beyond the immediate, biologically urgent goals. They are the conceptual tools that we employ to maintain and enhance self-esteem (Rokeach, 1973). Terminal and instrumental values are relevant when considering types of behaviour students engage in in classrooms (Knopke & Leon de la Barra, 2013).
3.4.6 Role modelling and peer support

Role-modelling, refers to the individuals who provided support and guidance to the participants in the case studies. The term can define a person whose behaviour, example or success can be emulated by others, especially younger people (Dictionary.com., Unabridged, http://dictionary.reference.com/browse/role+model). Peer support, is defined as the social, emotional and technical support (actions and gestures) that individuals provided to the participants in this study within the classrooms. Pintrich and Schunk (2002, p. 384) define peer networks as groups with whom students within a sociocultural framework.

King (1997) argues that caring born out of collaborative learning is not only about using students as coaches but as an integral part of a learning culture which becomes the empowerment to learning. The aim is to get teachers to view classrooms as cultures which include values, beliefs, norms and practices. Teachers need to develop a sense of community related to a large number of positive outcomes for students. This concept is often misinterpreted by teachers as needing to create positive interpersonal relationships. Students see teachers who care as having the following qualities: demonstrating democratic interaction styles, developing expectations for student behaviour in light individual differentiation, modelling caring attitudes to their own work and providing constructive task-specific feedback (1997). Teachers, in this sense become living examples for students. In the words of Mahatma Gandhi, You must be the change you wish to see in the world (Ghandi, 2008).

3.4.7 Socio-cultural approaches to learning

Socio-cultural approaches to learning are defined as those that provide instruction which recognizes and empowers linguistically and culturally diverse students (Wajcman, 2004). Socio-cultural theory which describes learning as distributed, interactive, and contextual and the result of a learner’s participation in a community of practice (Smith, 2003) grew from the Vygotsky belief that adults and peers influence individual learning along with cultural beliefs and attitudes that in turn impact on instruction and the learning which takes place (Vygotsky, 1978).

Hoepfl (2007) in arguing for differentiated instruction provided a definition which refers to a variety of classroom practices that accommodate differences in students’ learning styles, interests, prior knowledge, socialisation needs, and comfort zones (2007). Benjamin, (2002) argued that inclusivity is about attending to the learning needs of small groups and individuals. It reflects what Gardner (1993) has called individual-centred education: Instead of ignoring (individual differences) and pretending that all individuals have (or ought to have) the same kinds of minds, we should instead try to ensure that everyone receives an education that maximizes their own intellectual potential. (p. 71)

The third underpinning premise for this study examines the type of critique used by feminist writers. While all seek to unmask social issues writers of the radical and the Marxian schools seek to investigate from a negative/ subjective point of view (Wajcman, 2004). Such a
view says that all women are oppressed and hence in need of some rescue. This study, however, takes a positivist perspective in unearthing the voices of females in Technology Education through an ethnographic methodology. This is explored and addressed further in Chapter 4.

This research examines the possibility that it is the modern socio-cultural liberal feminism and awareness of gender issues that will enable young women to move past their historic roles in society to achieve some degree of equality in learning. It is a self-awareness of the factors which may alter the situation.

Socio-cultural approaches to learning provide instruction which recognise and empower linguistically and culturally diverse students (Wajcman, 2004). Socio-cultural theory describes learning as distributed, interactive, and contextual and the result of a learner’s participation in a community of practice. The collaboration of thinking that results from these processes opens up access to direct data on thought processes and provides avenues to uncover distinguishing characteristics and recognize the interdependence of concepts (McCormick, 2008).

The goal in using an ethnographic case study approach is to establish a process and provide ways of documenting change and transformation in the female learners from the study. Some discussion will be given to the concept of the Social Construction of Technology (SCOT) as written by Bijker, Hughes and Pinch (1987). The SCOT framework has for several decades provided a vehicle for the exploration of social constructionism as a critically and politically engaged set of views on knowledge and science. The framework provides a more applied model which recognises invention and creativity as social processes (Bijker, 1987; Herrnstein & Murray, 2006).

Socio constructivism is an open ended process where knowledge is constructed through the interplay of existing knowledge and the individuals’ social experience. It is an individual theory. It has been used in relation to pedagogic strategies and instructional design models which as a learning theory emphasizes the impact of collaboration, and negotiation on thinking and learning. Society plays a developmental role for the individual and the teacher acts as the scaffold of learning (Johnson 2002; Vygotsky 1978). Learning is a communication process via the interactions an individual has with those around them. Learning designs should be about local collaboration and the interactions to learn are with the domain experts the teachers who guide the learning process (Doise & Mugny, 1984). Collaboration is the key in the learning process and learning within a techno-social sphere may be the best environment for females. Bijker (1995) claims that there is a process of closure, reflecting on aspects of technical change and stability over time which shows that everything can fit into a technological frame comprising of knowledge, goals, and values as well as artefacts (Bernstein, 2003).

Social constructionism stemming from the Vygotskian notion of activity theory is a social phenomenon (John-Steiner & Mahn, 1996). This social construction of reality which stems from humans as social beings is an ongoing and dynamic process where people act on
their interpretation and knowledge of reality. Social constructs are not from nature but ones that must be constantly maintained and re-affirmed in order for them to persist. The origin of social constructionism in the post-modernist movement says that gender is socially constructed. Gender, as a construct, is not created by nature as a result of biology but rather created by and contingent on social and historical processes (Oldenziel, 1999; Oldenziel, 2003; Stanley, 1993; Vygotsky, 1978).

To prepare students for the future, Technology educators must seek alternative ways to conceptualize their subject matter to reach the diverse population of citizens in society. Technology educators must rethink the way in which they legitimize the knowledge of Technology Education for students in order to meet their needs and wants. (Wright, 1992, p. 212)

Wright argues that the social commitment must legitimate the principle of difference, to encourage and multiply different kinds of people and positions and values for their own sake, within the bounds of social order. As Wright indicates, “It is through the legitimacy of difference that new and necessary forms of rationality will emerge” (1992, p. 212).

As with postmodernist theories such as Wright's (1992), feminist theories encourage diversity in their view. Feminist theories encourage us to tolerate and interpret ambivalence, ambiguity, and multiplicity as well as to expose the roots of our needs for imposing order and structure no matter how arbitrary and oppressive these needs may be. “If we do our work well, reality will appear even more unstable, complex, and disorderly than it does now” (Flax, 1987, p. 643). Both postmodern and feminist theories point to diversity as a direction for the future and can provide some of the ideology for Technology educators' avoiding a restricted cultural view and creating change in the profession (Zuga, 1996).

The research of Zuga (1996) and Wajcman (2004) has examined the stigma of artefacts and highlighted the sociotechnical approaches which stemmed from social studies of Technology (Wajcman, 2004). It was the characterisation of Wajcman’s ‘techno-feminist’ which represented a major development in theorising the gendered character of Technology (Wajcman, 2004). Cyber-feminists were coined as a cultural term in social theory by Haraway in a quest to expose the gender blindness of main stream techno-sciences studies in order to show the possibilities this area offers women and how they could strategically engage (2004). The empirical work of Belenky, Goldberger and Tarule (1986) looked to find the voices of women and continues to be a revered work.

The underlying approach is to raise the consciousness of gender and the feminist uses of the construction of ideas (Belenky et al., 1986). Biological differences between sexes do not determine gender, gender attributes, or gender relations. “Gender in this conception, is a constitutive social construction” (Belenky et al., 1986, p. 8), a social category whose definition
makes reference to broad network of social relations, not anatomical differences (Haslanger 1995, Durack 1997). This leads to the final theme of values in Technology Education.

3.4.8 Values within Technology Education

Values within Technology Education include internal and external values which come into play at different points of learning for students. Pavlova and Turner (2007) have shown that values can and do motivate students in Technology Education classes. Values have been examined within Technology Education research, and are largely treated as gender neutral. Pavlova’s 1999 research addressed values in terms of sustainability and access. It is the issue of personal values as espoused by Rokeach (1973) which underlie the feminist perspective and how these translate into education at the personal and local level which relate to this study.

3.5 Conclusion

There is a need for studies to examine why female students are not opting to take up Technology Education in senior secondary school settings. Because of the need and the calls through research writers this study has adopted the theoretical framework which enables the researcher to look closely at the feminist notions which underpin this practical area. The seven themes have provided a framework through which to analyse the results and form a number of recommendations for this and other studies. The ethnographic case study methodology conducted in each of the sites, in the same manner, has provided the parameters for each study.

The socio-technical constructionist framework supports the study by presenting the seven themes through which the research took place. The socio-cultural theory has provided pedagogical and design parameters for the research and focussed the study back to the notions of collaboration and negotiation as an educational outcome. This section of the framework has provided links between the variables that may have occurred in each of the case study settings and has provided a set of boundaries which have framed the study.

The final framework of postmodern liberal feminist theory links to the two parts of the framework already discussed. The positivist perspective adopted looks to unearth the voices of females in Technology Education. In raising an awareness of gender, this study aims to have young women move past the historic roles that society continues to dictate and aim for sustainable change in encouraging greater numbers of females to engage in Technology Education.

The following chapter examines the methodology used in the research study.
Chapter 4

Methodology

4.1 Introduction

This chapter describes and justifies the methodology and the design used in the research through an examination of the concepts, structures and values that are specific for females learning in Technology Education. The chapter will outline the methodology that was used to examine the social structures and language discourses that established the social context and classroom norms in Technology Education sites. The study concludes by identifying strategies with which engage more girls in learning about and participating in Technology Education subjects.

The first of three research questions being investigated is - what factors have influenced female student’s choices to take Technology Education classes as part of their senior school pathways? It will do this by an examination of the social construction of realities from the individual and the collective group point of view. The second question being investigated is - how teaching and learning is constructed and approached in Technology Education classrooms? The third and final question being investigated is - what values are addressed in the teaching and learning in specific contexts of Technology Education for classes?

The literature review provided an analysis of research that examined gender in education and females and technology, language and more recent STEM research that has focussed on Science. Little in depth recent research exists on gender and the language discourse which stems from Technology Education classrooms despite calls for this research emerging more often. There is even less Australian research on Technology Education, and hence the calls for the research community to respond.

Seven themes emerged during the literature review. The first five were: learning ecology, gender and Technology Education, language use in classrooms, socio-cultural approaches to learning, and Values within Technology Education. These themes shape the classroom learning ecology in which students operate. Two other themes emerged as a result of the pilot study and further research. These were; motivation and role modelling and peer support. Collectively, the themes shaped the interview questions and observations used while visiting the case study sites.

The following outlines the methodology which was undertaken to address differences in settings in order to explore the critical issue and address the research problem of engaging more females in Technology Education.


4.2 Methodology

An ethnographic case study design was chosen as a framework for this study for a number of reasons. As stated in the literature review ethnographic research design aided the study of the behaviour, beliefs, language and how shared patterns of interacting in the educational setting have developed over time. It is a collective or multi instrumental case study approach comprising of several cases that provide insight into the research issue (Creswell, 2012). It is an instrumental case study as it highlights the issue of participation of females. The study is ethnographic due to the search for shared patterns that are part of the group interactions across the three sites that were part of the study (2012).

The nature of the research undertaken focussed on girls who were identified as the culture-sharing group, the subject of this study. This approach described, analysed and interpreted the patterns of behaviour identified with the females. Culture by definition covers all human behaviour and beliefs and includes the study of language, rituals, structures, life stages, interactions and communication. During the period of data collection in the field (observation and interviewing) the researcher focussed on the small group in several sites. The study describes and then analyses the culture-sharing group and interpreted their patterns within the context of culture-at-work. This reflective inquiry style employs a consciousness about the research and writing and aims to be respectful of the participants (Creswell, 2012).

The research study has examined three senior secondary high schools in South-east Queensland. The researcher took on the role of participant observer visiting the schools and classes over a fourteen week period. This involved visiting classes regularly and following the units of work with the classes and their teachers. In undertaking a case study approach, there was a need to describe the school, the classes and the general environment.

Ethnography looks closely at the students involved in the study. As participant observer it was possible to work beside the female students, and get to know them on a professional level. There were no restrictions on photographing the students or recording their voices or the researcher moving about the room and talking to staff and students after ethical clearance and parental permission were obtained. The environments encouraged academic rigor and students were aware of high standards that students were expected to meet.

The data for each case study was analysed through data sets. These included: interviews, observation data, audio recordings, photographs taken by the researcher. The interviews included conversations with the female students, the teachers in each of the case studies and the Head of Department (HOD). Notes were developed from the research journal and class observation sheets and reflections after each learning sequence.

As the purpose of this study was both hermeneutic and emancipatory the use of ethnographic case study as a methodology helped to promote reflective practices that examined
culture, knowledge, and action. This approach provided insights about fundamental questions of social existence that was at times ignored or not explored by other approaches (Thomas, 1993). By raising the awareness of females’ presence or absence in the Technology Education classes the social consciousness aim of this research method has been achieved. “There are emancipatory goals to negate repressive influences that lead to unnecessary social domination of some groups” (Thomas, 1993, p. 4). Hermeneutics (the science of understanding) aims to reduce the refraction of images distorted by science’s interpretive prism by translating what is seen as one set of cultural symbols to another for an audience. While this study does not take the critical approach it does aim to describe, report and analyse the influences on one marginalised group within three educational settings.

Ethnographic emancipation as an act of cultural liberation loosens the unrecognised symbolic constraints that restrict our perception, interpretation, discourse and action and shows that things are not always what they seem. Constraints that give some groups unfair advantage to the disadvantage of others, or social elements that exclude some from full participation in and the benefits to resources commonly available are considered as part of this research study. Unnecessary social domination exists when constraints are built into cultural and social life in ways that promote inequality. “The norms that distribute power in language use, shape deference, social rituals or shape access to educational courses are several ways that some people are able to dominate others in culturally acceptable ways” (Thomas, 1993, p. 5). The existence of values in any discourse is unavoidable. The aim in this methodology is to “confront values and rather than expunge them from research, identify them and assess their impact” (Thomas, 1993, p. 21). There is no value free research such as that promoted by Weber in 1946 (Thomas, 1993, pp. 21). We let the data speak to us, we do not prejudge or impose preferred meanings and use ‘ought’ ahead of is. The researcher has aimed to analyse by looking for emergent themes in the data collected from the Technology Education classrooms, the interviews and the observation notes.

Emerging feminist research is advocating for mixed methodology approaches to research (Hesse–Biber, 2014). Data of numbers of females in secondary school classes have been obtained and used to determine what classes could be used in the study (QSA, 2012). The lack of quantitative data will not support a quantitative methodology but does contribute information to the qualitative, ethnographic case study research used in this study. The analytical fit comes from qualitative data, ethnography and links to the language (in culture) that is in use. The methodology was guided by socio-cultural framework that encompassed a feminist construction of technology. Feminist critiques in Technology by Wajcman (2004) and Spender (1980) as seminal works shaped this analysis. Some subscription to post-modernist ethnography is acknowledged in terms of gendered images that are socially created via the media. Gendered
images that youth see every day could in fact shape and modify the participant’s views of their role in Technology Education, its links to language in use and this study (Eckert & McConnell-Ginet, 2003).

An ethnographic case study was used in this research study to unpack learning and Technology approaches within each Technology Education classroom. The approach addressed the second of the research questions. Socio-cultural approaches to learning provide instruction which recognizes and empowers linguistically and culturally diverse students. Socio-cultural theory describes learning as distributed, interactive, and contextual and the result of a learner’s participation in a community of practice. The collaboration of thinking that results from these processes opens up access to direct data on thought processes and provides avenues to uncover distinguishing characteristics and recognize the interdependence of concepts (Merriam, 1998; Pintrich & Schunk, 2002).

The goal in using an ethnographic case study was to give voice to the females who were part of the study. Belenky et al. (1986) speak of the “silence of women and the need to listen to the voices of constructivist women in order to alter the social landscape” (1986, p. 17). The case study is foremost in that it provides a bounded study for each of the sites that were part of the study. Hoepfl (1997) in examining research paradigms focussing on the use of qualitative methodology argues for the responsible implementation of the research and a plausible connection between the observations and the conclusions drawn.

Learning within a techno-social sphere may be the best environment for females. Bijker (1995) claims that there is a process of closure, reflecting on aspects of technical change and stability over time which shows that everything can fit into a technological frame comprising of knowledge, goals, and values as well as artefacts. Elsewhere, Bernstein (1981) looked to the goal of using a socio-cultural methodological approach to establish a process and provide ways of documenting that change and transformation.

Student backgrounds in terms of socio-economic experiences also influence what they choose to study within school settings. Life experiences and vocational aspirations of students will further contribute to the shape of the contextual area of this study. The impact of earlier curriculum studies on students, will have an influence on what students choose to study in the latter years of schooling in preparation for work.

The study subscribes to the following notions, that feminist researchers ask new questions and strive to give voice to women’s experiences especially related to knowledge that traditional research approaches have marginalised. Feminist researchers look to reach multiple understandings of the nature of social reality especially for women’s concerns and standpoints (Hesse-Biber, 2010). They address issues of difference by studying across difference, gender, race and class while stressing the empowerment of women in research processes. Reflexivity is given merit as an awareness of power imbalances between the researcher and participants, was
addressed while being mindful of research concepts and listening throughout the study. Finally feminist research addressed the importance of social justice, social transformation and social change in Technology Education settings (Hesse-Biber, 2010).

4.2.1 Ethnographic case study methodology

Yin (2003) suggests that there are five applications for case studies in research. The most important application is to explain causal links to real life interventions; secondly, to describe an intervention in the real-life context in which it occurred and thirdly, to illustrate topics within an evaluation, in a descriptive mode. Case studies explore situations in which the intervention has no clear, single set of outcomes and finally, fifthly the case study may be the meta-evaluation with the aim of arriving at a set of generalisations.

In using ethnography this study interchanges the word for ‘case study’ (Pole & Morrison, 2003). The study acknowledges the possibility of other methods in ethnography. This study focuses on qualitative methodologies and the detail of examining the voices that are within the research context. Ethnography as a process is about the analysis to which the data is subjected and the manner in which the data are used in constructing ethnography as a product (Pole & Morrison, 2003). The aim is to enhance the understanding of a social action within the educational setting and allows us to view the wider social and economic context of which the study is a part while holding onto the detail of the specific location, time and setting.

The case study was bounded by the Technology studies classes and the female students in the Year 11 classes. The research considers the complexity of each setting and looks to provide a collection of detailed data and a detailed analysis according to the identified themes. The contextualised description of the social action within the location can be described as rich and thick (Griffin, 2008). The portrayal of the “insiders perspective should take some precedence over the researcher, however participant-observation in the case studies are a form of observation that does not depend solely on ethnographic or participant data” (Yin, 2003, p 11).

Stables and Kimbell (Stables, 2008) found that visiting schools on three occasions and reviewing with learners what they were developing in a project provided a rich data source. As a method for examining learning this study advanced earlier research that simply evaluated outputs. Stables and Kimbell (2008) used both interviews and observational techniques via codings to gain greater depth of research than earlier studies.

As participant observer, it was possible to work beside the female students, and get to know them on a professional level. There were no restrictions on photographing the students or recording their voices or the researcher moving about the room and talking to staff and other students. The environments encouraged academic rigor and students were aware of high standards that they were expected to meet.
The case study approach took account of the location which was grounded in the collected data and incorporated a conceptual framework that facilitated an understanding of social action at theoretical level. Ethnographic case study was identified as the most appropriate instrument with which to gather data and analyse it. Yin (2003) argued that case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context (Yin, 2003). In a setting such as an education one which sees multiple sources of evidence this method was the most appropriate choice. “Ethnographic research in this case aimed to use close-up, detailed observations of what was occurring naturally as evidence” (Yin, 2003, pp. 14-15).

In undertaking a case study approach, there was a need to describe the school, the classes and the general environment for each of the case studies. This was done at the commencement of each of the case studies presented in Chapters 5, 6 and 7.

The data for each case study were analysed through four data sets. These included interviews, observation data, audio recordings, and photographs taken by the researcher. The interviews included conversations with the female students, the teachers in each of the case studies, and the Head of Department.

4.2.2 How the data were collected

4.2.2.1 Interviews

Interviews were completed through using the open ended questions supplied as part of the study. These related to the research question and sub-questions. The interview schedules differed for HOD/ Administrator, teacher and for students. Some interviews were conducted one on one with the researcher making notes, others were conducted with a recorder and then the dialogue was transcribed. Others were completed with the participant having the questions on the sheet of paper and writing comments on the responses side. Some sheets were handed to the researcher and discussed while others were forwarded via email.

4.2.2.2 Observation data

The researcher was participant observer in the classrooms and workshops where the Technology activity was occurring. Nine visits were made to Case Study 1. Eight visits were made to Case Study 2 and five visits to Case Study 3. Durations varied from one lesson usually a double of 50 – 90 minutes to two full days of activity in the five visit site. When this time is equated to double lesson length time this would total approximately 11 lesson length visits for Case Study 3.
4.2.2.3 Photographs and recordings

The researcher as participant observer took photographs and placed a recorder as close as possible to where the students were working. Field notes were made on a check sheet and in the field notes booklet. The problem in making notes, while in the class setting (at the time), was that student interactions were missed. The researcher was writing and missing what was happening in the class. Notes and observations were written up as soon after the lessons as possible.

Audio recordings have been transcribed in order to analyse the interactions that occurred where the students were working, to record the interactions of the teachers and peers in the class and to hear what was happening around the students. Not all the audio has been useful as at times machinery such as extract airs, electric drills and saws made it difficult to hear what was being said at the student’s benches. In other cases the nature of the practical work meant that there were not a lot of personal conversations recorded as the students worked in silence on their artefacts.

Data were categorised and systematically analysed in order to answer the research questions as to the examination of Technology Education classrooms that enable females’ participation in Design and Technology learning in an effective classroom environment that encourages greater engagement of female students. The sub questions examined what factors influenced female’s choices of Technology Education. Secondly, how teaching and learning was constructed and approached in the classrooms that encouraged female students and finally what values were addressed through teaching in specific contexts of Technology Education classes that may influence the participation of some students and not others.

The data for each case study were analysed through the four data sources. These included: Interviews, observation data, audio recordings, and photographs made by the researcher. The interviews included conversations with the female students, with mixed groups of students, the teachers in each of the case studies and the HOD along with comments from Deputy Principal’s and one principal.

4.3 Contribution of ethnographic case study research

Ethnography is involved in the reflection and reform of social settings. This type of research does not merely contribute to academic discourse about the classroom and school settings, but aims to engage in active reform processes, encouraging practico-reflective awareness and theoretico-reflective awareness. By people being willing to put their own truth claims into the research conversations Carspecken (1996) argues that morally social research will either hurt or help people, and that it rarely has purely neutral effects with respect to human welfare. “Making the research project as democratic as possible, and as transparent as possible from start to finish,
is the best way to help rather than harm” (Carspecken, 1996, p. 207). Thomas (1993) argues that insights gained through ethnography find differences in the views of the researcher, the subject and from these insights the study may change. Such a study is a dual transaction process for the subjects, the scientific nature of research and for the audience. The outcome is to gain insights into the culture of the study that will promote a more emancipatory state. The work of Kimbell (1994) in analysing Technology tasks in 80 projects in 20 schools carried out via observations shows that there is more teacher direction at the secondary school level than at the primary.

In challenging the cultural status quo this methodology will provide some challenges to the notions of traditional Technology Education classrooms. The first success of the study is measured by the degree to which the data and analysis conveys to others something that was not previously recognised. The second reason for this research is the emancipatory potential to free individuals from existing forms of cultural domination (i.e., male operations and language in Technology Education classrooms). Habermas (1971) contends that the only knowledge that can truly orient action is knowledge that frees itself from human interest and takes on a ‘theoretical attitude’. Theoretical attitude is one that recognises the sources and consequences of the power of ideology and language in producing what we call truth. Thus, the study seeks truth in data analysis. The final justification is moral philosophy. There is an ethical obligation on the research to uncover and rank social values. The ontology of critical thought includes a conception that there is something better and that the goal of knowledge should include working towards it. In looking for ‘the story’ this methodology is directed toward challenging long held techniques and authority.

The ethnographic method was used in the case studies to unpack learning and Technology approaches within Technology Education classrooms. The goal in using an ethnographic case study is to give voice to the females who were part of the study in terms of why they choose to participate. Belenky et al. (1986) spoke of the silence of women and the need to listen to the voices of constructivist women in order to alter the social landscape. The case study format is foremost in that it provides a bounded study for each of the sites that were part of the study. Hoepfl (1997) in examining research paradigms focussing on the use of qualitative methodology argues for the responsible implementation of the research and a plausible connection between the observations and the conclusions drawn.

This research requires an understanding of the subjects, culture and the researcher as a way of dispelling myths and misconceptions that format social structures and behaviour. It is about challenging comfortable but repressive, cultural definitions and providing an invitation to engage in social change. Given that the research is within an education system and a school setting, this must be done with subtlety and adherence to data. It is a powerful means to understand the educational culture and think about new ways of inclusiveness in the educational
settings related to this study. The methodology interwoven with feminist perspectives provides the potential for transformation.

4.4 Socio-cultural framework

A socio-cultural approach was the framework for this study. As an epistemological framework it provides a platform for socio-constructionist belief that knowledge is formed and transformed within specific contexts, shaped and expressed through different media, and processed in different people's minds. “It is about the dynamics of change” (Ackermann, 1992, p. 6).

Socio-culturalism provides the platform for research whilst consideration is given to the socio-constructivist and social constructionist theories. Some discussion will be given to the concept of the social construction of Technology (SCOT) as written by Bijker, Hughes and Pinch (1987). The framework provides a vehicle for the exploration of social constructivism as a critically and politically engaged set of views on knowledge and science which provides a more applied model than does the constructivist approach with its broader set of views on the nature of knowledge and cognition (Herrnstein & Murray, 2010). Socio-cultural theory describes learning as “distributed, interactive, and contextual and the result of a learner’s participation in a community of practice” (Merriam, 1998, p. 35). The collaboration of thinking that results from these processes opens up access to direct data on thought processes and provides avenues to uncover distinguishing characteristics and recognizes the interdependence of concepts (Pintrich & Schunk, 2002).

Whilst choosing not to follow a Marxian feminist argument there is an acknowledgement that power relationships can benefit one group and not another. Critical-theory in this sense can be seen as ideology rather than methodology which makes inequalities obvious (Willis, Thompson, & Sadera, 1999). In the past it has not been seen to produce positivist results, however modern researchers in Technology Education have developed positive results related to teachers as reflective practitioners.

As a research design an ethnographic case study aids the study of the behaviour, beliefs, language and how shared patterns of interacting in the educational setting have developed over time. The focus is on females who are identified as the culture-sharing group, the subject of this study. This approach helps to describe, analyse and interpret the patterns of behaviour identified with females. Culture by definition covers all human behaviour and beliefs and includes the study of language, rituals, structures, life stages, interactions and communication.

During the period of data collection in the field (observation and interviewing) the researcher focused the study on individuals and small groups. The study describes and analyses the culture-sharing groups and interprets patterns within the context of culture-at-work. This
reflective inquiry style employs a consciousness about the research and writing and aims to be respectful of the participants (Creswell, 2012).

Socio-cultural methodology is described by Robinson, Wiegmann, and Nichols (1992) as a specialised way of evaluating instructional materials, teaching and the artefacts that were a product of the activity. This study looked to the holistic view of socio-culturalism to frame the research.

In challenging the cultural status quo, the ethnographic case study questions the notions of traditional Technology Education classrooms. The first success of the study is measured by the degree to which the data and analysis conveys to others something that was not previously recognised. The second reason for this research is the emancipatory potential that Habermas (1971) argues can ‘free individuals from existing forms of cultural domination’ (e.g., male operations and language in Technology Education classrooms, which will be explored). Habermas (1971) argued that the only knowledge that can truly orient action is knowledge that frees itself from human interest and takes on a theoretical attitude.

This research requires an understanding of the participants, culture as a way of dispelling myths and misconceptions that format social structures and behaviour. It is about challenging comfortable cultural definitions and providing an invitation to engage in social change. Given that the research is within an education system and a school setting this must be approached with subtlety. It is a powerful means to understand the educational culture and think about new ways of inclusiveness in educational settings related to technology. Ethnography interwoven with the feminist perspective provides the potential for transformation. Some settings may not need any transformation but rather the examples and practices of those sites can be researched and documented for transference to other educational settings. The following outlines the research design used in the study.

4.5 Design

4.5.1 Research Design

The research used a qualitative approach where data were collected through observations and interviews with students, teachers and some administrators in selected sites. An ethnographic research approach was used due to the focus on a potentially marginalised group (i.e., females in Technology Education). To date this is an under-represented group. Issues such as power and authority may emerge as causal to why females are in these classes in such small groups (Creswell, 2012).

Classrooms and practices which attract female students as Technology Education learners were the subject of the study. The particular interest area was classrooms that
effectively engaged female students in Technology Education, the learning and pedagogy within that domain (Weber & Custer, 2005).

The aim of this study was to examine classes in schools which had significant populations of female students in them. Four students were to be selected in each class to be observed and interviewed. Depending on the availability of the students some the interviews were individual or small groups. These, like the interviews with the teacher and HOD, were conducted on site at times suitable to the school.

The research, through the research questions aimed to:

- Identify positive/dynamic Technology environments in co-educational classrooms.
- Develop a set of criteria that would indicate what makes them thriving/engaging places for gender participation (identified from QSA data classes with larger numbers of female entrants)
- Examine what was occurring prior to students entering into the senior secondary classrooms.
- Analyse what subjects the females had studied prior to them taking up the subject in that year.
- Overview the content of the teaching programs and topics.

4.5.2 Sites/ Settings

The sites which were selected for the research study were secondary schools located in the south east of Queensland offering senior secondary subjects in Technology Education. QSA data were obtained from 2008 – 2012 which showed the total numbers of students in a course of study which included Engineering Technology, Information Processing and Technology, Graphics and Technology Studies. The data show that numbers in these classes were as low as ten participants in total. The percentage of males and females is shown in Figure 4.1.

In this study, selected schools were examined, and research observations and semi-structured interviews were conducted with participants. McCormack (2008) elaborates on case studies as a data collection useful as a methodology to see a phenomenon under investigation in context. McCormack (2008) argues that seeing knowledge as situated implies that it is “interwoven with context and taking place in a social and physical context related to action” (p. 7). Observation was the first step to becoming familiar with the teaching/learning setting. Beginning as an observer and then spending some time as a participant observer allowed the researcher to be familiar with the context of the learning and the participant’s part in the Technology Education setting. Moving from the role of outsider to insider in the learning context required multiple visits to the same classroom with the same subjects. Limiting this to one unit of work provided a suitable time frame and continuity.

4.5.3 Site selection

The schools selected were those teaching senior secondary Technology/ Engineering Studies as a QSA registered subject. The specific schools selected for the study had class sizes of ten or
over and all had females as members of the classes. Schools chosen were accessible to Brisbane. While some of the student numbers in the classes were low the classes were the settings which encompassed this study. In order to understand the issues it was necessary to research within the school and class settings. A description of the cultural setting for each school and a context for the group being studied will be part of the research setting and results.

The highest enrolment of females as illustrated in Figure 4.1 can be seen with the blue line. Additional research needs to be undertaken to examine if high female numbers belong to a school because of its teaching program because of the geographical location of the site or whether there are teachers or career factors which heighten the figures in some schools and not others.

**Figure 4.1 Technology Studies Schools (QSA, 2012)**

Data for Technology Studies over the years 2008 -- 2012 are presented numerically in Table 4.2, then graphically in Figure 4.2. The representations provide an example of total numbers in the classes and the percentages of participation of females in one school over five years (QSA, 2012). Overall, the data demonstrate that the number of females are significantly lower than male participants in the classes.
Table 4.1 Sample of Class Composition over 5 years

<table>
<thead>
<tr>
<th>School B</th>
<th>S.H.S.</th>
<th>% Females</th>
<th>Total in class</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Technology Studies</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>2009</td>
<td>Technology Studies</td>
<td>3</td>
<td>33</td>
</tr>
<tr>
<td>2010</td>
<td>Technology Studies</td>
<td>22</td>
<td>18</td>
</tr>
<tr>
<td>2011</td>
<td>Technology Studies</td>
<td>17</td>
<td>35</td>
</tr>
<tr>
<td>2012</td>
<td>Technology Studies</td>
<td>23</td>
<td>22</td>
</tr>
</tbody>
</table>

Figure 4.2. Data illustrated graphically for one school 2008 – 2012

4.5.4 Participants

Participants were Year 11 female students who were willing to collaborate in the research as part of their Technology Education studies. By the nature of their choice, they were involved in the data collection. Staff assisted with targeting certain students to be interviewed. Ideally, the students were to be selected from across the academic range; one high achieving student, two mid-range students, and one other. Given that these students were new entrants into the course and the low numbers available, all of the participants who were approached, joined the study. Teachers as well as administrators were seen as equal participants in the research study in terms of their contribution to Technology Education in the sites of the study.

4.6 Data Collection

Multiple forms of data were collected. Data could be anything that individuals were willing to provide – observational data followed by semi-structured ethnographic style interviews and taped recordings of the class and individual/group interviews. A combination of data sources as recommended by Pichler (2008), who stated that, “Spontaneous talk and semi structured interviews provided richer data and a greater interpretative capacity for the researcher to analyse and reflect on linguistic and social practices” (2008, p. 56).
4.6.1 Instruments

Data collection instruments included contextual information about the school, the department within the school, the teacher and the learners at each school. The key instruments were observations, audio recording within the classrooms, interviews with students and staff and an administrator and artefact analysis. Each instrument was analysed with respect to the themes in the study.

Table 4.2 One Unit of Work – Process used for Data Collection

<table>
<thead>
<tr>
<th>In classrooms</th>
<th>Observer researcher</th>
<th>Number of observations</th>
<th>Collection instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Participant observer</td>
<td>X 1</td>
<td>Research log Data recording</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X 2</td>
<td>Data recording</td>
</tr>
<tr>
<td></td>
<td>Participant observer</td>
<td>X 1</td>
<td>Research log Data recording</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X 1</td>
<td>Summary photograph – artefact Repertory Grid</td>
</tr>
<tr>
<td></td>
<td>Artefact</td>
<td>X 1</td>
<td></td>
</tr>
<tr>
<td>In Interviews</td>
<td>With students</td>
<td>1 x 4 or 2 x 2</td>
<td>Data recording Semi structured interview schedule QUESTIONS Verify what was observed. Photos of artefacts Repertory Grid for discussion</td>
</tr>
<tr>
<td></td>
<td>With teacher</td>
<td>1 x 1</td>
<td>Artefacts/ documents photos</td>
</tr>
<tr>
<td></td>
<td>With HOD/ Administrator</td>
<td>1 x 1</td>
<td>Documents and planning into total curriculum &amp; unit. Artefacts</td>
</tr>
</tbody>
</table>

Refer to research questions For use by the researcher Each time in a site As listed

4.6.2 Outcome

The outcome of the observation in classrooms tested the criteria for good/ positive ecology of classroom. Examples of what was in the learning environment (ecology) showed that learning was:

- Tool rich
- Trusting
- Supportive – of 7 components of classroom ecology (Siemens, 2003).
Chapter 4. Methodology

The seven themes reaffirm the research questions under examination. The socio-cultural feminist view sought to find the feminist voices through an examination of the context of the setting of the schools and the nature of the Technology departments within which the case study research took place. Each theme: learning ecology; gender and Technology Education; language use in classrooms, motivation; role modelling and peer support; and values within Technology Education all contributed to the socio-cultural approach to learning that affects female students.

4.6.3 Observations

Observation as a technique was used to view and then unpack the interaction between participants. These were linked to the audio taping of the lessons in order to recall what the participants did during the observation period.

Observations verified data that was discussed in the interviews with the participants. Multiple site visits over the course of one teaching unit allowed the researcher to see the participants and the class on at least three occasions and to understand the setting as well as the unit and artefact being developed. The researcher moved from being a non-participant observer to a participant observer (Stables, 2008), as the subjects become more familiar with another person in the classroom. The aim was to get inside the social and cultural realities of the classroom as the observer moved from being non-participant to becoming a participant with the aim of producing qualitative data (Stables, 2008).

Observations were made in the form of notes under the key headings by the researcher while located within the classroom as participant observer. These interactions were peer to peer, teacher to student, student to female, and student female to male (Modi et al., 2012).

The observation diary which included the observation and record sheets of some of the language and personal interactions in the classroom was kept as a record to the research activity. There was no intention to preference one participant over another, however, a focus on the identified student participants enabled more targeted data to be captured. Observations included looking for stereotypes in line with the gender specific focus of this study.

4.6.4 What was observed?

The participants and the teacher in each classroom were the focus of the observations. The second factor was the artefacts.

It was necessary to view the student participants in context of the class and its members, the interaction with the teacher and the setting. The recording of the body language, and positioning (seating and moving – classroom plan) of some participants were key to analysing the class interactions.
It was important to examine the artefacts that were the focus of the Technology Education class. The artefacts (and the factors which contribute to the development of the product) were fundamental to the activity at hand.

Observing teachers as part of the general classroom interaction enabled the researcher to discuss the Technology Education program and students (interactions and artefacts) as part of teacher interview. In doing this, the researcher looked for the interactions in personal, interpersonal and environment influences on student participants and teachers and recorded them in the observation log.

4.6.5 How

Observations were carried out by the researcher as participant observer using a check list of key headings such as those used in the Stables (2008) study. The check sheet was used to enable the researcher to quickly note what the participant was engaged in over the course of the class lesson and to link this to the audio tape when it was reviewed following the data collection.

There was some criticism that interaction analysis suggests insights into general patterns of communication in classrooms. The method relies on the outside observer’s frame of reference and interpretation which was not the inside frame of reference nor the interpretation of the teacher and students. The following table provides a structure for observing the classroom ecology (Weber & Custer, 2005).

4.6.5.1 Framework for observation checklist

<table>
<thead>
<tr>
<th>Table 4.3 Framework for Observation Checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checklist for classroom observation of students</td>
</tr>
<tr>
<td>Environment – informal, flexible, participants create according to their needs.</td>
</tr>
<tr>
<td>Tool rich – learner’s dialogue and connect within the classroom.</td>
</tr>
<tr>
<td>Consistency and time. There is a knowledge sharing ecology and an evolving environment in which participants operate.</td>
</tr>
<tr>
<td>Trust – with social contact. It may be face to face or online. There is comfort and participants feel secure and safe.</td>
</tr>
<tr>
<td>Simplicity – simple social approaches to the ideas and activities that are developed. The selection of tools and the creation of the community structure reflect this same principle.</td>
</tr>
<tr>
<td>Learning in the classroom is de-centralised, fostered, connected as against centralised, managed and isolated.</td>
</tr>
<tr>
<td>High tolerance for experimentation and support for failure.</td>
</tr>
<tr>
<td>Empowerment of individuals</td>
</tr>
</tbody>
</table>

The aim of the framework presented in Table 4.3 was to allow for a checklist of headings to gather data in note form, during the visits to the school sites. Data gathering included contextual
information about the school, the department within the school, the teacher and then the learners.

4.6.6 Observations

4.6.6.1 Interaction Analysis

One aim of observation was to unpack the interaction between participants. As outlined above, interaction analysis suggests insights into general patterns of communication in classrooms due to the outside observer’s frame of reference. The Observational Research and Classroom Learning Evaluation Project (ORACLE) in the United Kingdom over five years in 1980 (Hitchcock & Hughes, 1989) observed teachers and students through observation schedules involving researchers recording at selected intervals what was happening in the classroom. In that study there was a 25 second observation interval carried out by a team of rotating researchers.

While the Hitchcock and Hughes (1989) schedule provides a structure in terms of questions, statements and silences, the issue of the need to record paralinguistic features such as facial expressions, eye movements, glances, expressions and interpersonal communication are not included in depth (1989). Some of these interactions such as proximity need to be included but not all can be recorded and the validity of this study will not be diminished because of their omission.

The reliability in terms of replicability of the study from one researcher/observer to another using the same instruments in this study will be transferable in terms of the semi-structured questions for the participants. The recording of the body language, and positioning (seating and moving) of some participants is key to analysing the class interactions.

4.6.6.1 Audio recording for language use

The second data collection instrument was audio recording in the classrooms that were observed. Placement of a recorder in order to capture their specific discourse during the class was important. One general recorder may capture some of the teacher and the general class dialogue. The recordings applied to interviews with students, teachers and the administrators in each school.

4.6.7 Why

The literature review adopted the social construction of language as outlined by Spender (1980). Further research pinpoints socio-linguistics stemming from linguistics and the structure of language. The thesis will consider in the audio recordings of interviews and the classrooms. Socio linguistics focuses on the use of language in social contexts and on the relationships
between language, talk and society, and between language, culture, community and neighbourhood. It makes use of insights, concepts, methodologies and theories from other disciplines while concentrating on the social relationships in language use in social contexts and highlights the abilities of the speaker and the influence and effects of the social environments surrounding the speaker (Hitchcock & Hughes, 1989). The aim is to analyse language used in context of the Technology classes.

### 4.6.7.1 Factors affecting Language use in the classroom

**Table 4.4 Factors affecting language use in the classroom**

<table>
<thead>
<tr>
<th>Sender</th>
<th>Identity, status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Position of speaker, social class</td>
</tr>
<tr>
<td></td>
<td>Language used</td>
</tr>
<tr>
<td>Receiver –</td>
<td>Person being spoken to – will influence speech style used by sender. Adult-child conversation.</td>
</tr>
<tr>
<td></td>
<td>Categories – official to inmate</td>
</tr>
<tr>
<td></td>
<td>Social hierarchy/ status hierarchy</td>
</tr>
<tr>
<td></td>
<td>Social characteristics and identity of receiver crucial variable</td>
</tr>
<tr>
<td>Setting</td>
<td>Context</td>
</tr>
<tr>
<td></td>
<td>Determining factor in language</td>
</tr>
<tr>
<td></td>
<td>Influence language use</td>
</tr>
<tr>
<td>Age</td>
<td>Age of teachers/ students factor in verbal interaction</td>
</tr>
<tr>
<td>Class</td>
<td>Socio-economic, (frame of reference) Bernstein model.</td>
</tr>
<tr>
<td></td>
<td>occupational position</td>
</tr>
<tr>
<td>Gender</td>
<td>The dimension affected is the same as attitudes to social class of speaker and hearer and influences the nature of verbal communication and interaction</td>
</tr>
<tr>
<td></td>
<td>Socially constructed and structured perceptions can align with roles of behaviour.</td>
</tr>
<tr>
<td></td>
<td>Affects communication from:</td>
</tr>
<tr>
<td></td>
<td>rights of access to talk,</td>
</tr>
<tr>
<td></td>
<td>changes in tone</td>
</tr>
<tr>
<td></td>
<td>changes in style of language used from one group to another</td>
</tr>
<tr>
<td></td>
<td>changed vocabulary used.</td>
</tr>
</tbody>
</table>

In order to examine the use of language within a feminist study in Technology Education classrooms, the critical feminist perspective of Spender (1980) has been drawn upon. Modern authors have labelled her early work determinist with a focus on (non-) sexist language but she is more recently documented as having brought about a feminist inspired language change. The feminist and critical linguists acknowledge that no approach to the analysis of language can or even should be objective. We have moved from viewing male dominance throughout the political period of women’s liberation of the 1970s and 1980s, to cultural difference brought about by the advent of social constructionism. The impetus behind much gender and language study is to uncover the inequality of mixed-sex talk. The notion is that
language is used to construct gender “Social constructionism sees gender as the active, interactive, negotiated construction of gender, including self-positioning” (Sunderland & Litosseliti, 2008, p. 4). Linguistic dealings with women, men, boys and girls, for example, what is said to them, each of the groups, and what is said and written about gender differentiated tendencies, are important.

4.7 Data gathering techniques

Social constructionists de-emphasise gendered speakers as agents, focusing rather on what is communicated by, to and about women, men, boys and girls. The use of a recorder (MP3) was used in the interviews and classrooms to capture the verbal interactions of the participants for later analysis with the aim of hearing the voices of the participants in their natural setting.

4.7.1 Interviews

Three types of interviews were undertaken as part of the study; namely, interviews with student participants, interviews with teacher participants and interviews with an administrator in each of the schools.

The semi-structured nature allowed for some probing and encouragement to have the participant, through non-leading questions, explain and describe the context of the class itself along with its ecology, the design work and the practical work that was being undertaken as part of the class. In having students and teachers discuss their work and interactions that occur in the Technology classroom the researcher should gained insights into the language and cultural interactions.

Validity checks were undertaken with the key participants. The validity techniques were; debriefings with students, checks with the subject teachers, interviews, consistency checks, use of recording device and engagement in the field (Korth, 2001).

4.7.2 Student Questions

4.7.2.1 What

The type of questions used were semi-structured interview questions to produce an in depth examination of the issues related to female students. The questions related to their participation and inputs/outputs in Technology Education classrooms.
**Table 4.5 Question schedule for students**

<table>
<thead>
<tr>
<th>Sample questions that were used in the student interviews.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you been involved in technology education classes at primary or lower secondary school?</td>
<td>Res Q 1, Q3</td>
</tr>
<tr>
<td>What factors that led you to consider taking Technology education classes?</td>
<td>Q1, Criteria Q 4</td>
</tr>
<tr>
<td>What do you understand to be the content of the unit you are doing?</td>
<td>Q2 socio-cultural approach</td>
</tr>
<tr>
<td>What products/artefacts have you designed or made in class?</td>
<td>Res Q 2/3</td>
</tr>
<tr>
<td>How do you feel about the item you are working on now?</td>
<td>Q3</td>
</tr>
<tr>
<td>Why take a subject in the Science, Technology, Engineering or Maths (STEM) area of learning? (Values question)</td>
<td>Q1</td>
</tr>
<tr>
<td>Please comment on the classroom environment (setting/colours; numbers of people in the room; how do you prefer to learn – individually or in a group)</td>
<td>Q3 (ecology)</td>
</tr>
<tr>
<td>Who do you choose to work with in technology – boys or girls, random groups, friends?</td>
<td>Q1, 3</td>
</tr>
<tr>
<td>Would you recommend Technology Studies to your sibling/friend? Why/why not?</td>
<td>Q3</td>
</tr>
<tr>
<td>Explain what you like about the subject</td>
<td>Q4</td>
</tr>
<tr>
<td>What do you like about what you are doing in this subject</td>
<td>Q4</td>
</tr>
<tr>
<td>Future ambitions do you have from taking the technology subject?</td>
<td>Q2,3</td>
</tr>
<tr>
<td>Discussion on values – what do you see as values addressed in Technology education?</td>
<td>Q3</td>
</tr>
<tr>
<td>What do you (student) believe are the teacher expectations for you in the class and within the design/technology project?</td>
<td>Q1, 3, 4</td>
</tr>
<tr>
<td>Do you have a male or female Teacher – would the class or you act differently if you had the opposite?</td>
<td>Q3, Q4</td>
</tr>
<tr>
<td>Student view of Teaching/pedagogic style and how do you like/prefer to learn?</td>
<td>Q4</td>
</tr>
</tbody>
</table>

### 4.7.2 How

The interviews were conducted toward the end of the Technology unit that was being observed with individual or pairs of female student’s in order to triangulate the data that the researcher had observed and recorded from the perspective of the participant. Some students recorded their answers on a checklist such as the one above.

### 4.7.3 Teachers

#### 4.7.3.1 What

Questions asked of the teachers aimed to overview the program and their view of females in the Technology classrooms. Samples of the questions used are included in Table 4.6.

#### 4.7.3.2 Why

Dialogue with the teachers was key to understanding the interactions and the participants in the Technology Education classroom. In defining best practice and the characteristics of good
Technology Education for females and how these teachers have met with some success, it was important to record the data.

**Table 4.6 Sample question schedule for Teachers**

<table>
<thead>
<tr>
<th>Sample questions that were used in the Teacher interviews</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where does the unit that is being observed fall within the program/ course content and context?</td>
<td></td>
</tr>
<tr>
<td>What are the past and present goals of the technology program for this school?</td>
<td></td>
</tr>
<tr>
<td>What steps can be taken to promote gender participation in Technology classes – both male and female?</td>
<td></td>
</tr>
<tr>
<td>Discussion on Values – provide definition – what do you see or believe are used or inherent in Technology education?</td>
<td></td>
</tr>
<tr>
<td>The Vocational Education agenda and school links with VET – do you consider post school options and students when deciding on your program and projects?</td>
<td></td>
</tr>
<tr>
<td>Qualities of a successful classroom</td>
<td></td>
</tr>
<tr>
<td>Is there a difference between learning styles of female and male students in technology education. If yes can you provide some examples from your experience?</td>
<td></td>
</tr>
<tr>
<td>Qualities of a successful student</td>
<td></td>
</tr>
<tr>
<td>Qualities of a successful female student</td>
<td></td>
</tr>
<tr>
<td>These include the future of the discipline as the teacher sees it – STEM/ Engineering /The fading/ leaking pipeline</td>
<td></td>
</tr>
</tbody>
</table>

4.7.3 How

Teachers were interviewed individually and the interviews recorded. This was done at the end of the Technology Education unit of study in order to discuss the progress the student participants had made over the time of the research study.

4.7.4 Administrator

4.7.4.1 What

Administrators in a school were the principal, deputy principal, subject area co-ordinator or HOD. Sample questions are outlined for use in this interview in order to compare one school site with another.

4.7.4.2 Why

One administrator in each school site was interviewed in order to gather data on their perspective of females in the Technology Education classes in their school. The administrator provided an overview of where Technology Education sat within the school curriculum.
offerings and what subject areas were timetabled at the same time as the Technology Education classes.

**Table 4.7 Interview schedule of Administrator questions**

<table>
<thead>
<tr>
<th>Sample questions that were used in the HOD/administrator interview</th>
<th>Responses/notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>What factors make the Technology Education classes a success for this school?</td>
<td></td>
</tr>
<tr>
<td>Have you or your timetabling staff made a conscious effort to include females in Technology education?</td>
<td></td>
</tr>
<tr>
<td>Are there any qualities/characteristics that you look for in a female who wishes to participate in a technology class?</td>
<td></td>
</tr>
<tr>
<td>Do you see the engagement of females in this subject area as important? More important as students or as teachers?</td>
<td></td>
</tr>
<tr>
<td>Discussion on Values – what are the values embodied in the subject area?</td>
<td></td>
</tr>
<tr>
<td>Ecology – interactions and social constructivism of the class environment</td>
<td></td>
</tr>
<tr>
<td>Are some teachers better at catering to both genders or teaching the subject and engaging everyone regardless of gender?</td>
<td></td>
</tr>
</tbody>
</table>

4.7.4.3 **How**

An interview was conducted with one administrator of the school and recorded to be used as the final triangulation of data about the females in the Technology Education classes.

4.8 **Artefacts**

Artefacts related to Technology Education included made items and products as well as documentation related to the products. They included drawings, sketches and designs created by students and teachers. The artefacts were photographed. Participants’ judgements were collated into repertory grid and included in the research diary.

Crilly (2010) argues that the role that “artefacts play can be both practical and reflective of their social means” (p. 311). An artefact is assigned a function if it is taken to have the capacity to play some role for an agent using the artefact in context. In this sense the innate and intrinsic use of an artefact may have more value to some students than others. Artefacts perform technical as well as non-technical roles.

Products of student unit work in the units and works in progress, were viewed, photographed and discussed with the participant as part of the observational data. Like language use, these were analysed from a non-technical, socio-cultural perspective. Persson (2010) used a
repertory grid technique to examine artefacts and their characteristics. Aligning this to the work of Wajcman (2004) she notes the nature of artefacts as linked to social networks in which they are developed. The gendered nature of work with artefacts needs to be explored (Persson, 2010).

4.8.1 Why

A repertory grid (Table 4.8) was included in order to have participants comment on their artefacts. This enabled some evaluation by the participant student and teacher and became part of the data collection for the study. In keeping with the socio-cultural framework the criteria in the repertory grid aligns with the key questions in this study.

Table 4.8 Repertory Grid - Artefact rating table

<table>
<thead>
<tr>
<th>Place a ranking against the aspect that relates to your artefact. 1 is low 5 is high.</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design is guided by shape</td>
<td>Design is guided by function</td>
</tr>
<tr>
<td>Must meet teacher specified requirements</td>
<td>Artistic freedom/ not may requirements</td>
</tr>
<tr>
<td>Form and function in balance</td>
<td>Not complete, not finished, unbalanced</td>
</tr>
<tr>
<td>Thoroughly worked form</td>
<td>Form result of construction</td>
</tr>
<tr>
<td>Nostalgia,sentimental value</td>
<td>No feelings to the product</td>
</tr>
<tr>
<td>Suited to its purpose</td>
<td>Entertaining</td>
</tr>
<tr>
<td>Pretty</td>
<td>Ugly</td>
</tr>
<tr>
<td>angular</td>
<td>Organic</td>
</tr>
<tr>
<td>Pleasant</td>
<td>Unpleasant</td>
</tr>
<tr>
<td>Not quality</td>
<td>Quality</td>
</tr>
</tbody>
</table>

| Rank from 1 lowest | Ratings | 5 - highest |

4.8.2 How

Students were asked to complete the repertory grid. A printed sheet with the grid was supplied to the student for them to complete and bring to the interview to discuss. This was collected and analysed in conjunction with the observations and interview responses.
4.8.3 Documents from teachers

Teachers were asked to discuss their work programs and unit outlines related to the products and processes that the students engaged in during the unit that was observed.

Each analysis chapter is divided into three parts, the teacher, students, and the HOD (administrator) for that site.

4.9 Collection and analysis of the data

4.9.1 Interviews

Interviews were completed through using the open-ended questions supplied as part of the study and these related to the research questions. The interview schedules differed for HOD/ Administrator, Teacher and students. Some interviews were conducted one on one with the researcher making notes, others were conducted with a recorder and then the dialogue was transcribed. The final set were completed with the participant having the questions on the sheet of paper and writing comments on the responses side. Some sheets were handed to the researcher and discussed while others were returned via email.

4.9.2 Observation data

The researcher was a participant observer in the classrooms and workshops where the activity was occurring. Nine visits were made to Case Study 1. Eight visits were made to Case Study 2 and five visits to Case Study 3. Durations varied from one lesson usually a double of 50 – 90 minutes to two full days of activity in the five visit site. Equated to double lesson length time this would total approximately 11 lesson length visits for Case Study 3.

4.9.3 Photographs and recordings

The researcher as participant observer took photographs and placed a recorder as close as possible to where the students were working. Field notes were made on a check sheet and in the field notes booklet. The problem with making notes, while being in the class setting, was that student interactions were missed. The researcher was writing and not seeing what was happening in the class. Notes and observations were written up as soon after the lessons as possible.

Audio recordings were transcribed in order to analyse the interactions that occurred where the students were working, to record the interactions of the teachers and peers in the class and to hear what was happening around the students. Not all the audio was useful as at times machinery such as extract airs, electric drills and saws made it difficult to hear what was being said at the student’s benches. In other cases the nature of the practical work meant that there
were not a lot of personal conversations recorded as the students worked in silence on their artefacts.

4.10 Data

The following outlines the data which were collected for the research study. It then outlines how the data were analysed according to each of the themes.

4.10.1 Data preparation

Data were collected and then collated after each site visit.

4.10.2 Visual data

Multiple photographs were taken of each days visit. These showed the progress of the projects the students engaged in as well as some of the skills and machinery the students were learning and using.

4.10.3 Taped Data

This was an invaluable source of data especially in the interviews. The tape recorder ran in the open air settings but it was often away from where the students were working or machinery was turned on and little sound could be used.

4.10.4 Field notes

These were relevant to reflect on and were completed both at lunch breaks and immediately after the classes.

4.10.5 Instruments for data collection

Instruments for data collection included observations, sound recording within the lessons, and interviews (sound recorded). The observations included students and their teachers in the selected sites. The participants and their parents agreed to engage in the research study as part of their course. Artefacts were viewed and discussed as part of the engagement of the participant in the course and in the context of the classroom activity.

Recordings were listened to and transcripts of selected parts of the material were used to classify and code language and the activity in the discussions. The material was coded and stored securely for later use in the study.

Interviews were conducted separately as a semi-structured conversation with students from each of the classes and with each teacher.
4.10.5.1 Observations

Observations were made in the form of notes which were collated under the key headings. It was intended that these were made by the researcher located within the classroom as participant observer.

An observation diary included the notes and record sheets of some of the language and personal interactions in the classroom were kept. Given the time restraints and quantity of data it was not possible to record all of the interactions.

4.11 Data analysis

Data analysis incorporates the instruments which were used. These include the observations, interviews, artefacts and documents that were used in the field study.

Key questions related to the subject areas in schools were: What factors influenced female and male choices in Technology Education? What were the cultural norms of the subgroups? Secondly, how was teaching and learning in Technology Education constructed/approached in the classroom? What were the gender differences? The final question asked what values were addressed through the teaching and learning in specific contexts of the Technology Education classes and teaching programs. This question relates to the language analysis.

4.11.1 Observations/field recordings

Data were analysed and collected to allow the researcher to begin to look for patterns in what was being collected and to further refine and make adjustments throughout the study (Gay, 2009). Analysis of the data was guided by the research questions. Data collection and codings occurred as soon as possible after the observations were made. The participant observer had an empathy and understanding of the issues at hand and was able to identify the common themes as they emerged as part of the study (Stables, 2008).

The researcher read through data to develop overall understanding of it as soon as possible after one site visit before the continued visit to that site. Coding of the analysis occurred according to the themes related to ‘critical’ issues being explored in study as they emerged (Gay, Mills & Airasian, 2011, p. 164).

As the researcher became more familiar with the setting and the situations the subjects were working and studying in, patterns of routine and behaviour emerged. This triangulated what was being recorded in the class and then reported during the interviews.

Recorded data from the MP3 players was downloaded onto a laptop then transcribed. Not all of the data were transcribed due to the quantities recorded. NVivo 10 software facilitated the handling of large amounts of data and searched for similarity of words in text in the analysis. NVivo was used to identify common key words and phrases. Using this program
enabled an examination of emerging interpretations and understandings. The researcher looked for connections and concepts emerging in the data, while comparing data to theory and the existing literature.

4.11.2 Interviews and observations

4.11.2.1 Observations

The following outlines what the researcher looked for in observing and participating in the Technology Education classes and in the interviews.

The recorded data verified the observation notes that were made in the classroom. They focussed on the participants in the study. Cross-checks soon after the site visits were necessary in order to verify that the data collection methods were reliable.

The second aim was to observe teachers as part of the general classroom interaction enabling the researcher to discuss the Technology Education program and students (interactions and artefacts) as part of teacher interview. In doing this the researcher looked for the interactions in personal, interpersonal and environment influences on student participants and teachers and recorded these in the observation log.

4.11.2.2 Observation notes

Observation notes were taken in the classrooms and typed into the software program. A set of codes were developed once the data were recorded in order to identify the issues. Some parts of the data recordings were transcribed and form part of the data analysis.

Data were placed into the NVivo program in order to categorise the observation notes and provide a further source of qualitative data for the study.

4.11.3 Identifying characteristics of successful classrooms

Observations were made of students in their classroom environment through participant observation. This was the first aim. “Sociology aims to get inside the social and cultural realities of the classroom as the observer moves from being non participant to becoming a participant with the aim of producing qualitative data” (Stables, 2008, p. 135).

The second aim was to observe teachers as part of the general classroom interaction. This enabled the researcher to discuss Technology Education programs and students (interactions and artefacts) as part of teacher interview. In doing this, the researcher looked for the interactions in personal, interpersonal and environment influences on student participants and teachers and recorded them in the observation log. Finally, the third aim was to triangulate the data by an administrator/ HOD being interviewed to assess their views on the class that had been observed.
4.11.4 Observation notes

Observation notes were made in the classrooms and typed into the software program. A set of codes were developed once the data were recorded in order to identify the issues. Some parts of the data recordings were transcribed and form part of the data analysis.

4.11.5 Interview data

4.11.5.1 Questions to be asked of the teachers

The research sought the teacher’s view on the Technology Education classes where the students had been observed. This provided a triangulated view of the data.

The semi-structured interview questions aimed to produce an in depth examination of the issue that enabled generalizable findings for future studies in other aspects of Technology Education.

4.11.5.2 Artefact analysis

Artefacts from students included the product under development as part of the teaching unit. This included any of the design work and drawings that were part of the design folio for the unit of study. Photographs were taken of artefacts as they developed and these were part of the discussion with the student participants and teachers during the interview phase.

Artefacts from teachers included the unit outlines and notes or samples of the topic of the unit of study. Artefacts from the administrators include the timetabling/planning documents to locate where Technology Education fitted in the school plan. Any of these artefacts were used in the analysis phase of the study.

4.12 Ethics

Ethical approval was provided through Griffith University processes. Education Queensland processes granted access to the schools with females in Year 11 Technology Education courses.

Sites were identified via 2012 data supplied by QSA related to Technology Education subjects. Once approval to approach schools was gained then contact with the school principal, Heads of Department and teachers was made. This happened at the commencement of the 2013 school year.

The study did not identify individual school sites but acknowledged their general location. Descriptions of the settings, the classroom context and the participants were provided but no third party identification was made. Each site and participant was respected for privacy. No participant was identifiable. Ethics reference: EDN/92/12/HREC.
Ethical issues in ethnographic research relate to fieldwork concerns. These related to gaining access to the site or staying within that setting, gathering the data and the interactions between the researcher and subjects (Creswell, 2012).

The participants were mostly minors and consent from guardians needed to be obtained in order to facilitate their participation and the recording of interviews and conversations. Given that the researcher was participant observer and seen as teacher, there may be an unequal relationship toward students but not for the teachers interviewed in the study. Culture and race which stems from ethnicity, did not impact on the actual engagement of the subjects in the Technology Education class. Participants identifying from cultural groups added a richness and further dimension to the ethnographic study.

The competence and integrity of the researcher in having held teaching and administrative as well as data assurance roles in schools up until recently, provided an assured level of respect for individual’s rights and dignity and a concern for the welfare of participants in the school sites. In some cases participants could have revealed personal information when discussing how they felt in the social context of that classroom. The researcher was bound by the code of ethics in these situations. Sites, participants and parents were provided with prior warning that some information revealed may be of a personal and subjective nature in order to find what it is that the participants enjoy or dislike about the subject and the context in which it occurred.

Questions of privacy of information revealed during the study in the context of what occurred in the classroom fall into the Queensland College of Teachers Code of Practice. In forming an analysis at the completion of the field work the nature of ethnography cast light on relationships but in a non-identifiable context to individuals.

Any collected data has been kept in secured cabinets in locked areas at Griffith University. These are only accessible to the research team. Items will be destroyed as they are de-identified and analysed.

The research plan evolved as the researcher entered the sites and more fully understood the culture of the study within each classroom. Issues of interaction with participants altered as the participants became more familiar and accepting of the researcher in role.

4.13 Strengths and Limitations of the design

4.13.1 Strengths of the research design

In evaluating the ethnographic study a specific culture-sharing group has been identified. That is, females in Technology Education classes. The research examined the concepts of power and acculturation that shaped the groups over time. In observing the participants the researcher, via the field work, was able to establish patterns of behaviour, language and beliefs. The strength of
Chapter 4. Methodology

this approach was that the data came from within and through the participant’s voices, actions and interactions in a naturalistic manner.

In gathering evidence through multiple sources, observations and interviews, evidence was analysed through the detailed descriptions of culture sharing group on context it existed in. Themes emerged that reflected major ideas about how the groups worked, and interpretations emerged as to how the group illustrated ‘culture at work’. The final strength of the ethnography is that the researcher can reflect on their own role in the study and how their own background, gender and history shape the account that was reported.

4.13.2 Limitations of the research design

One potential limitation was gaining access to sites with suitable candidates over an extended period of time. Once in the field, it was hoped that there were similarities between classes to enable the observation of patterns. While Education Queensland sites were targeted, due to low numbers of participants, it became necessary to approach private schools for permission for the research. The selection of schools may have been a limitation however there was sufficient range to enable replication of the study.

As participant observer careful attention was paid not to intervene in the learning or distort any possible findings. It is acknowledged that multiple interpretations exist and data may be interpreted differently according to the interpretation of the researcher.

Observations required some skill in order to make credible notes and jottings. The researcher learned how to funnel information from notes into case studies, acknowledge quotes, and not miss valuable information. The use of an audio-recorder, and camera (AV material) aimed not to be disruptive of the work in the class rooms, or to distort room sounds, while capturing what was needed.

The final limitation was documents, such as unit outlines, plans, syllabus material and department work programs. Locating these materials and gaining permission to copy them was an issue.

4.13.3 Assumptions

The following assumptions were taken into account. That not all the female participants in the study had engaged in Technology Education studies prior to their entry into the subjects which were part of the study. Secondly, schools that wished to engage as part of the study needed a teacher, class and female students who were receptive to the field work. Thirdly, there needed to be an identifiable group of female students with enough common characteristics to form a community of interest and identify as a cultural group from which the researcher could draw data. Fourthly, that there was sufficient data to analyse and review and themes that had been
drawn from literature review. Finally, that there was consistency of data from the selected sites studied and within the classes and subjects selected.

### 4.13.4 Time Schedule

It was anticipated that the study would commence at the beginning of the school year of 2013 and proceed through Terms 1 and 2. This time frame allowed for multiple site visits and to view the development of participants newly into the classrooms as well as view their engagement with the artefact and project work. This length of time allowed for multiple sources of information to be collected and researcher teacher collaboration in terms of best fit times for field visits. See Table 4.9.

**Table 4.9 Time schedule for the research on sites**

<table>
<thead>
<tr>
<th>Months 2013</th>
<th>Site 1 Example</th>
<th>Site 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>February</strong></td>
<td>Contact then visit the selected schools. General class observations Classroom Observation One full lesson for unit interview Admin</td>
<td>Student 1 site selections</td>
</tr>
<tr>
<td><strong>March</strong></td>
<td>Interview Teacher</td>
<td>Mapping of timetable of visits e.g. 2 visits per month</td>
</tr>
<tr>
<td><strong>April</strong></td>
<td>Class visits interview student/s</td>
<td>Continued site visits View at least one complete unit</td>
</tr>
<tr>
<td><strong>May</strong></td>
<td>Interview teacher/s</td>
<td>Continued site visits + classroom recording</td>
</tr>
<tr>
<td><strong>June</strong></td>
<td>Final interviews and reviews</td>
<td>Final interviews and reviews</td>
</tr>
</tbody>
</table>


4.14 Conclusion

The ethnographic case study methodology aimed to identify changes that needed to occur as a result of the research study. An outcome of this type of research was to actively advocate for change as a result of the suggested findings. The final chapter generalises the findings of the three case studies and discuss how the researcher and the participants (students and teachers) changed during the research process. A discussion will be provided on how the participants changed over the course of the study (Creswell, 2012).

The findings from the field work study are reported and analysed as part of the result and analysis chapters presented in Chapters 5, 6 and 7. The concluding chapter, Chapter 8, will advocate for specific changes from common findings which emerged from all three case studies.

This report reflects the methodological design and addresses the critical issues of gender in context and recommendations for further research as a result of the findings which emerged in the study. The structure of the methodological study provides a basis for replicability of similar studies in the future. In summary, this chapter has outlined the ethnographic case study methodology and processes that were utilised to collect site data from the schools, classrooms and individuals who expressed a willingness to take part in the research study.

There are a large number of un-researched concepts and socio-cultural aspects to be explored during the course of this research. The dynamic nature of such research meant that the study was refined once contact was made with school administrators and teachers in order to gain access to the classrooms and then be a participant observer within the sites. The reflective nature of ethnography means that the researcher was mindful of the nature and age of the participants and that their voices needed to be heard and recorded to enable more females’ to have greater voice and in turn greater participation in the long term. The following chapter is the first of the three reported case studies. Chapter 5 is the first of the three results and analysis chapters.
Chapter 5

The Technical of Technology

This chapter is the first of a suite of three chapters which present the results and analysis of the three case studies undertaken as part of the thesis. As noted in Chapter 1, the thesis explores the factors that encourage and facilitate female students to engage in design and Technology learning activities in senior secondary schooling. This chapter provides an introduction to the three results chapters and presents the results and analysis from Case Study 1. The analysis suggests that pedagogy that is more female friendly makes a positive difference to female engagement in a Technology classroom and details the characteristics of female-friendly pedagogy. Chapter 6 presents the results and analysis of Case Study 2, a school with an engineering focus. The analysis suggests that highly motivated students will overcome any barriers in order to achieve an instrumental goal that is part of their positive self-values. Chapter 7 presents the results and analysis of Case Study 3. The analysis suggests that a skills-oriented course with practical applications for students in the context of the school and its local environment that caters to the needs of its clientele will meet with success for both the program and its participants.

Each case study presented is divided into several parts: the teacher/s, the student, and the heads of department. Within each section are the themes which contribute to the analysis of each case study. These are divided into data results and analysis.

The following provides the results of the study and analyses the collected data under the headings identified from the literature review which framed the study. Results are provided at the end of each section. Seven themes emerged during the literature review. They are outlined in the following section.

The research questions, related to the subject area in schools, asked - what factors have influenced female student’s choices to take Technology Education classes as part of their senior school learning pathways? The second research question asked - how teaching and learning was conducted and approached in Technology Education classrooms? The third and final question asked - what values are addressed in the teaching and learning in specific contexts of Technology Education for classes and teaching programs?

5.1 Description of the themes

A brief description of each of the themes examined in depth in Chapter 2 is included below.
5.1.1 Learning ecology
The definition provided by Siemens (2006) is employed here. In that definition a Technology classroom setting that promotes learning, that is, a learning ecology contains seven elements for a knowledge sharing ecology in Technology Education. These comprise: flexibility; tool-rich; consistency and adequate time; trust; simplicity; learning is decentralised, fostered and connected; and there is a high tolerance for experimentation and failure. Learning ecologies are dynamic, living states as defined by Brown (2000). They can be further analysed through a definition of knowledge ecology as open systems, that are dynamic and interdependent, diverse, partially self-organising, adaptive and fragile (Brown, Collins, & Duguid, 1989). A learning ecology is a collection of overlapping communities of interest, cross pollinating with each other, constantly evolving. The literature says there are elements which are analogous to ecosystems such as rituals, response groups, individual class contexts and niches which are managed through the dependant roles of members. It is discourse between participants that defines the operational epistemology of the group.

5.1.2 Gender and Technology Education
Gender and Technology Education encompasses the social constructionist feminist perspective utilised in this study. The work is foregrounded by that of Zuga (1997) and Wajcman (2004) in her techno-feminist characterisation of Technology. Their work in exposing the cultural blindness of techno-science studies showed the possibilities that this area offered to women and how they could strategically engage and participate in STEM studies. The empirical work of Belenky, Clinchy, Goldberger and Tarule (1986) looked to find the voices of women that we continue to seek today.

5.1.3 Language use in classrooms
Language use in classrooms was investigated through the lens of Spender’s (1985) research which argues that men control language which, in turn, ensures opportunities from a power perspective. Language is as much written, spoken, gestured and positional discourse. Language was analysed in terms of control and conveyance of the messages related to Technology.

5.1.4 Motivation
Motivation is defined as the process whereby goal-directed activity is instigated and sustained (Pintrich & Schunk, 2002). Values is a theme that has shaped this study and it is values, argues Rokeach (1973), that have a motivational function: to guide human activity in daily situations.
5.1.5 Role modelling and peer support
Role-modelling, refers to the individuals who provided support and guidance to the participants in the case studies. The term itself can be defined as a person whose behaviour, example or success can be emulated by others, especially younger people (Dictionary.com., Unabridged, http://dictionary.reference.com/browse/role+model). Peer support, is defined as the social, emotional and technical support (actions and gestures) that individuals provided to the participants in this study within the classrooms. Pintrich and Schunk (2002) define peer networks as “groups with whom students interact within a sociocultural framework” (p. 384).

5.1.6 Socio-cultural approaches to learning
Socio-cultural approaches to learning are defined as “those that provided instruction which recognizes and empowers linguistically and culturally diverse students” (Wajcman, 2004, p. 105). Socio-cultural theory which describes learning as distributed, interactive, and contextual and the result of a learner’s participation in a community of practice (Arnold & Smith, 2003) grew from the Vygotsky belief that adults and peers influence individual learning along with cultural beliefs and attitudes and they will impact on instruction and the learning which takes place.

5.1.7 Values within Technology Education
Values within Technology Education include internal and external values which come into play at different points of learning for students. The works of Pavlova and Turner (2007) have shown that values can and do motivate students in Technology Education classes. Values that have been examined within Technology Education research have been largely treated as gender neutral. Pavlova’s (1999) research addressed notions of values in terms of sustainability and access but it is the issue of personal values which underlie the feminist perspective and how these translate into education at the local level which relate to this study as espoused by Rokeach (1973) and built on by Pavlova.

5.1.8 Structure
This chapter commences with an overview of how the results and analysis are presented. The three chapters (Chapters 5, 6 and 7) present the results and analysis of the planning and the observations of a unit of work in a senior secondary school setting in the area of Technology Education in each of three schools. This chapter presents Case Study 1, which is the first case study of one female participant. This case study was conducted in a school in the western suburb of Brisbane. The chapter has been analysed in themes according to those which emerged from the literature review and the data. Data were triangulated across the participants in each
site comprising: the researcher as participant observer; interviews with students, reflections, and interviews with teachers and HOD’s, audio recordings of classroom talk and photographic data.

This case study was undertaken in a highly ranked SES (Socio-economic school) school. The school describes itself as having high academic standards and students are focused on their work and the variety of extra-curricular activities in the school.

5.2 Case Study 1 - Teacher (T1)

The teacher (T1) was a Technology trained teacher who had been teaching approximately twelve years. T1 had come from a previous industry background. T1 initially chose to complete the interview questions on paper and agreed to forward them via email. T1 completed some of the questions and sent them electronically but asked to provide verbal feedback on the remainder rather than fill in the sheet. The teacher invited me to visit the school again and join with the students in the workshops and then chat with him.

The HOD and his teachers have trialled revisions of the syllabus in Technology Studies. Technology Studies is a Year 11 and 12 senior school course endorsed by QSA for use in the state by all schools who select to teach it. The teachers in the Technology department were active in their input toward the content and ideas in the syllabus document Technology Studies that is part of the QSA curriculum. The HOD was chair of the QSA Committee for Technology Studies. The QSA program (syllabus) outlines a program of study and provides information as to what assessment items must be completed by students so they can be granted grades according to the syllabus.

The following sections present the results and analyses of the teacher data in terms of learning ecologies.

5.2.1 Learning Ecology

The following provides the results for learning ecology in terms of the issues/themes that emerged during Case Study 1. These comprise: the view of the school and the department; assessment within the learning ecology; guidance versus independent learning; and the role of teacher demonstrations.

5.2.1.1 Results

5.2.1.2 The school and the department

The Industrial Technology and Design (INTAD) professional association saw the staff in this school as leaders in teaching Technology Studies through their program development. Student work was guided and carefully monitored to ensure success. T1 regarded the success that was achieved as being driven by students’ desires to fulfil parental expectations as much as meeting
state policy and school program requirements as well as the general parent and community expectations from the school.

The staff, the teacher, teacher aide and HOD were well aware of the external requirements of the QSA Technology Studies course and developed their local work program from this document. The staff were aware of the time limitations to meet the course requirements and worked hard with the students to assist them to meet assessment deadlines according to the school term calendar. Time restrictions meant there was little allowance for students to engage in experimental learning or risk taking if they failed and had to revisit part of a project.

5.2.1.3 Assessment within the learning ecology

T1 regarded the Year 11 student project work as constituting formative assessment work while the Year 12 project work was regarded as products for summative assessment. Interestingly, T1 chose these descriptors rather than adjectives about the work.

Aspects of the Technology Studies work program that the teacher regarded as important were the Year 11 work being used as a grounding in learning skills. The acquisition of basic construction skills for Technology Education is required in order to construct artefacts during the remainder of the two year course. The first unit of work in Term 1 was the making of a LED lamp and the second unit in Term 2 was a letterbox.

The researcher as observer attended these classes and saw the artefacts and processes from planning the design phase to the making phase and near completion. The photograph Figure 5.1 is an example of the tasks undertaken and of the development in skill level of the female student.

![Artefact construction](image)

*Figure 5.1. Artefact construction*
5.2.1.4 Guidance vs independent learning

The students worked close to the benches and developed their projects in a lock step fashion. Some of the male students who were experienced in Technology Education proceeded with their work without waiting for directions.

Students focussed their work on the teacher and his direction until they became more confident in the environment and then moved outward to work with a group of four students clustered at a workbench. As the teaching terms progressed students became more independent, made their own choices of tools and materials, and moved around the workshops more freely. The students found workspaces that suited their needs and the needs and space requirement of the projects they were working on.

Students in this teacher’s workshop were provided with guidance but the teacher stated his goal was “To turn them into independent learners” (T1). The students, who were all new to the senior school course, appeared to become more independent learners as the semester developed. By this it is meant that the students moved from being reliant on the teacher for every (process) lock step part of their project. As they became more confident they moved to discussions with peers at their work benches by way of decentralised learning. Some of the boys became independent quite quickly making decisions to construct before the teacher had endorsed where they were up to in the making of their artefact. Independent is taken to mean that they were confident to make decisions on their own and follow a course of action they had decided. This is different to decentralised where a group could collectively assist a learner to function without recall to the teacher.

T1 believed it was his guidance and the design process which helped students steer away from some ideas that were just too difficult for individuals. In guiding them he could provide for personal challenges on an individual competence level:

> If you are sick of doing metal and ……. and you want to come watch me… If you are making a dowel……. otherwise I will give everyone a yell if you want to come watch me, otherwise I will give a yell when I finish (T1).

T1 provided instruction and then allowed students to move away to their projects. T1 observed that some students were risk takers, and these were the male students, rather than the female learners. T1 believed that the maturation of the learners, over time as Technology Studies students helped them find solutions to problems as they became more confident:

5.2.1.5 Demonstrations

As part of the demonstration teaching, T1 modelled the learning and then encouraged students to do the task. The following transcript shows the teacher providing modelling in the workshop:

> If you are going to make a letter box out of metal, okay I did show you up in the theory room the other week how to do a net [drawing/diagram of the project].
record that for later. Basically 50 mil. sides and I did show you so you can cut it out of here with the shears (T1).

If you are going to use aviation sheets a guillotine is good for cutting it to size but a guillotine is not going to be able to cut this out (showing a paper template with rounded corners). So you are going to use aviation shears. ...The Red handles – so remember this is for cutting to the right. Straight or to left. The Green (Google it) for cutting to the right. Yellow just straight. So Just cut it. So to cut it out. Obviously you cut it. So what you want to do… Who can tell me how I should do this? Like scissors? I’ll give you a hint. For example if I am doing a reasonably long cut should I let the shears completely close? No… (T1).

Why not to SI? (T1 questioning the female student).

The female student shrugged in response and a boy answered:

You’ll get a bad edge. You’ll get a little ‘mark’ (T1).

Bad edge. You’ll get a ‘little mark’, says the teacher. So when you are doing a longer one aim to finish your cut, like as you see some people (T1).

At this point, T1 continued to explain in instructor mode about pop rivets and welding and completing corners:

…..depending on material, or you can drill a hole and do that as well. Now I can stand here and watch you do the rest. I’ll cut out the rest and watch you do it.... off you go....(T1).

T1 indicated that students were allowed to struggle with things in order to solve their design problems within the learning process. However, his concern was about students meeting time deadlines and finishing design challenges. There was little space for failure or experimentation in the schedule. The economic impact of the cost of materials was expressed as an issue for the school as well as parents.

The following provides the analysis for learning ecology. As with the results, the analysis of learning ecology for T1 in Case Study 1 is presented under the following headings: the view of the school and the department, assessment within the learning ecology, guidance versus independent learning, and the role of teacher demonstrations.

5.2.1.6 Analysis

The definition of learning ecology as defined by Brunner and Bennet (1997) says that there will be seven elements for a knowledge sharing ecology in Technology Education. These comprise: – flexibility; tool-rich; consistency and adequate time; trust; simplicity; learning is decentralised, fostered and connected; and there is a high tolerance for experimentation and failure.

The ecology of this classroom encompassed the themes (collectively) that were discussed earlier. Brown, Collins and Duguid (1989) conclude that there are elements which are analogous to ecosystems such as rituals, response groups, individual class contexts and niches
which are managed through the dependant roles of members. Not all of the elements could be identified in the classroom. There was some scope for student discussion at the work-benches, however, most of the work was individual and a result of interactions between the student and teacher. There was minimal student to student interaction at the beginning of the term, however, it did develop over time.

5.2.1.7 The view of the school and the Department

In terms of course programming this site can be described as a dynamic ecology (Brown, et al., 1989). The response from T1 was that his guidance in the design process helped steer students away from difficult tasks to ones that were manageable is interpreted in terms of Brown’s (1989) seventh feature that describes a positive learning ecology. Brown argues that a positive learning ecology provides a high tolerance of failure and encourages risk taking.

Many of the elements of a Technology learning ecology were met on this site. There was a flexible learning environment, that is, it was tool rich (Brown, et al., 1989) with a wide variety of tools the students could use. There were multiple resources to enable students to complete their design tasks. Any tools (such as drills, saws, planes, machines) that were needed to complete jobs were on hand or sourced from storage by the teacher’s aide. Availability of resources meant there was little waiting time for equipment and using Brown et al.’s (1989) analysis, concludes that these features lead to a positive learning ecology.

5.2.1.8 Assessment within the learning ecology

Assessment appeared to be a key driver of the learning ecology. However, given the nature of school timetable and program there was a limited amount of time for students to complete their design tasks. The teacher provided information and instructions and expected students to follow these. While T1 stated students were allowed to struggle there were few failures because of the time pressure to produce a product that met the assessment needs, the program requirements and the parent’s expectations. In reality risk taking was tolerated but given the lack of time to revisit projects and limited resources to re-make artefacts this aspect of the learning ecology did not appear to be a positive one. Pressure was put on the student to complete the task and get it correct the first time. All this was within the context of limited lesson times.

Belenky et al. (1986) and Rokeach (1973) would suggest that females would select activities and courses for their inherent value and their intrinsic worth rather than for marks. In T1 making these judgements on student work it may imply an assessment driven culture within the school and it is only assessment which provides a purpose for the work students engaged in. Female students may not choose to engage in an assessment driven courses.
5.2.1.9 Guidance

T1 did offer outside school time but few students indicated they would take that option. There was a mismatch between what T1 said and what was observed in the workshop. This is an important aspect in terms of female students. If they arrive in Technology classes with fewer skills than their male counterparts, then they will need more time, not only to complete the project, but to also learn the skills that sit behind constructing the artefact. Extra time in this respect is important.

The nature of this learning environment which talked about supporting female students meant that there should have been more girls wanting to engage in a safe nurturing controlled environment. From an onlookers stance this is perhaps not how the Technology Education class appears from outside. In reality once the female students join the department they remain. As outlined in the HOD (H1) interview:

Once they arrive, they stay (H1).

5.2.1.10 Demonstration

The Technology staff claimed they provided a supportive environment for females evidenced by the HOD’s statement. Pedagogical ecology as outlined by Nystrand, Gamoran and Carbonaro (1998) identifies the relationships of instructors and learners in learning environments. Ecologists study these symbiotic interactions to discover insights about the course and parameters of individual organisms’ behaviour and development. On the one hand, ecologists study grand ecosystems. On the other hand, they study far smaller and more particular ecological niches

Nystrand et al. (1998) argue that “the ecological niches are far more idiosyncratic, dynamic, and variable than the ecosystems of which they are a part” (pp. 3-4). Each setting has its own set of variables and parts which come together to create the whole ecological system. 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 (Nystrand et al.; Pavlova, 2009). The extent to which T1 supported the female student or believed he would support her appeared to make a difference to the learning environment in this classroom. The rituals and roles were understood by some of the students and slowly developed and learned by the female student.

5.2.1.11 Summary

The analysis suggests that female students will function differently in a learning context such as this one from say, a language class. Petrina (2007) argues that in order to address equity we may have to demand unequal treatment… some groups (i.e., girls in Technology) may require
differential treatment to have a fair chance to participate and perform. “Equal outcomes may require differential treatment” (pp. 333-334). Teenage females may also require design challenges that meet their needs which are different to the expectations of staff who are teaching them. Individual interest is a key motivation for the current generation of youth. We are now in the era of The App generation as described recently by Gardner and Davis (2013). In an era when we need to be catering for individuality, Gardiner and Davis claim that educators need to be approaching engagement with students differently. Gardner and Davis suggest that the ‘app connected, app enabled generation’ have had much of their creative imagination stunted and their connectivity and sense of identity development are very different to those that educators know and understand from past eras. Gardner and Davis say that creativity is not lacking but it has altered. Communication through identity development is a factor in teaching for understanding in females. (Belenky, 1986; Gardner \\& Davis, 2013, Petrina, 2007) The social constructionist elements as noted above contribute to learning for females (Knopke, 2012).

Stereotypes as well as gendered expectations shaped the ecology and the social structure within the workshop in this study. “If female students are inspired to engage in Technology departments and understand the reasoning and the processes required they will want a clear process to be able to follow in order to realise a finished artefact” (Petrina, 2007, p. 335). Female students will develop the required skills and knowledge in order to participate in the course but they need extra time to enable them to acquire the skills.

There appears to be evidence that the female student (S1) faced no competition in the environment. She was supported by T1 and was able to participate in learning new skills without any pressure from her male counterparts in this learning environment. The following section examines the role of gender in Technology Education in relation to the teacher.

5.2.2 Gender and Technology Education
The two results to come from T1 with respect to gender in Technology Education were construction skills development and thinking skills.

5.2.2.1 Results
The teacher saw the second unit of work (the letter box) as important to the female student’s work in terms of her construction skill development but also in building her confidence in the subject:

Speaking during his interview, T1 saw the subject of gender as a consideration in the workshop. The concern was in developing basic skills in the workshop for participants.

When asked did the development of basic skills matter, T1 stated that in S1’s case it did matter as S1 was totally new to the subject area and had no prior experience of dealing with resistant materials. One example from a dialogue in the workshop:
Alright everyone gather around... [Loudly] (T1).
Sir what’s in the folder, so what are we doing.....? (S1)
You're going to do a letter box – as you would (T1).

The interview dialogue focussed on the ability of female students to take on a task and achieve it. In relation to gender and the artefacts the teacher stated he did not believe they (the staff) could do anything different for girls.

He asked:

What should we do, make a jewellery case? (T1).

T1 shrugged and the interview moved to the variety of artefacts produced by students from Year 10 to Year 12 in the Technology Department.

In terms of thinking skills, the teacher believed that what the students were making provided a good balance that met the QSA’s verification and production criteria for the course and they were able to showcase examples from the school program. Photographic evidence of the work, along with the student log books were kept and completed during the learning units. The teacher noted that there were three girls in Engineering Studies and more in Graphics. T1 claimed:

The way to encourage female students into Technology subjects [is] through promoting thinking skills. We should promote thinking skills that may be acquired [through designing and making the artefact] rather than the focus being on the artefact (T1).

T1 stated that some of these actions could be done through the planning phases and then through the design process that was in the student workbooks. There were examples of guided projects for the students in their class booklets. T1 explained the process:

So the assignment that was due in..... the assignment was around the planning of this for the assignment. I’ll show you the sheet if you like... (speaking to the observer) they [the students] had to plan it [the letterbox] show some research materials, joining methods, we had to research tools....(T1).

The analysis of skills development and thinking skills shows that the interview focussed on the ability of female students to take on a task and achieve. The notion of a gender neutral curriculum emerged. T1 had stated that he did not believe that the staff of the Department in the school could do anything differently for girls when he asked:

What should we do, make a jewellery case? (T1).

The researcher noted some of the literature which said that there was teaching aids and methods that girls preferred and that there was a notion of female pedagogy (Petrina, 2007). T1 shrugged and we moved on to the next questions in the interview.

T1’s response is interpreted in terms of Linnenbrick and Pintrich’s (2002) research which developed the notion of mastery and performance. According to Linnenbrick and
Pintrich, if we teach only for performance - as an end product then we do not achieve the motivational factors which occur when we teach for mastery. The skills which develop and flow from mastery become important in order to perform the task at hand (Linnenbrink & Pintrich, 2002; Pintrich & Schunk, 2002). When teaching female students it is the adaptation of pedagogy which may make the difference to their performance and empowerment in the classroom.

5.2.2.2 Analysis

The notion of construction skills development and engagement versus thinking skills development may be analysed in two ways; one the females taking ideas on board may stem from the traditional social compliance of females vs. males. Secondly, the case study analysis has shown that females will analyse a situation in order to understand it. They will apply the thinking skills they know and strategies they have learned in order to progress the project. The approach taken by female students as described by T1 is interpreted in terms of Belenky, Clinchy, Goldberger, and Tarule’s (1986) argument that through the social process of discussion and analysis females can analyse a task and apply the most suitable methods to solve and complete the task.

The literature (Belenky et al., 1986) has shown that female students need a values based reason to select a class and then to become successful in their functioning in that context. This is discussed further in the motivation theme.

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 (Weber & Custer, 2005, p. 56).

T1 reinforced the Weber and Custer finding when he stated: Engaged and motivated students make effective classrooms and students need to see the value in what the program can deliver before they will fully engage (T1).

In this sense T1’s concern appeared to be with the results, the deliverables as the end product of the course rather than the engagement and enjoyment within the process of learning and construction.

Classrooms that effectively engage female students in Technology Education, the learning and pedagogy within this domain are those to be identified (Weber & Custer, 2005). Siemen’s (2006) seven components identified in the learning ecology which provide a basis for the analysis are not all met in relation to gender in this instance. “Educators should not accept that this generation of learners will learn according to how male teachers see the content and the subject (Belenky et al., 1986). Traditionally Technology has been a male dominated teaching area. The profession realises that there is a need for modernisation and change (Williams, 2009).
The student interview data presented in the second section of this chapter shows that the student took this class ‘for something different’ (S1). The reason is not congruent with the ideas expressed by the teacher. T1 appeared to have spent considerable time supporting the student and developing her skills. His actions appear to have in turn bolstered her confidence in the workshop. Taking a class for the wrong reasons may not encourage other females to follow on if there is a lack of commitment or motivation to achieving the goals in that class. A minimum target of female participation for the school may have been met but there will not be a spread of enthusiasm amongst the student population.

5.2.3 Language use in classrooms

5.2.3.1 Results

Language use in the classroom was not discussed directly with T1. However, T1 did at times refer to the class as ‘gentlemen’ and would after a pause add, ‘and lady’ seemingly reminding himself of the addition to the class.

5.2.3.2 Analysis

Talbot (2010) writes that an individual’s language will vary according to the needs of the social context. This may vary according to the formality required by the relationship between speaker and hearer and what they are talking about but also because of other aspects in the social setting. The general language use of the teacher is consistent with the findings of Spender (1980) and Eckert and McConnell-Ginet (2003) that the default language use will always revert to male dialogue because of their social positioning. In this case study, the tentative nature of the position of S1 in the class and the teacher’s dialogue did not serve to strengthen her entitlement of a strong place in that context. From a feminist point of view, it reminded the hearer that the female learner was the extra student in the class. At that point in the school year, S1 may have still been considered an outsider due to her lack of experience in the workshop setting.

5.2.4 Motivation

In discussing motivation as a factor which will sustain interest in students and particularly female students ‘the process whereby goal-directed activity is instigated and sustained’ T1 believed that engaged and motivated students made effective classrooms. T1 stated that students needed to see the value in what the program could deliver before they would fully engage. Learning in this context was not about the artefact but about the program. When the researcher questioned T1 about the qualities of a successful student T1 responded:

…it was one who is able to, …follow the design process through an entire journey – design proposal (folio) production and appraisal (T1).
The results of the same question put to the teacher but focussing on a successful female student elicited the response that they:

*Showed attention to detail, and thoroughness while taking advice from the teacher on board (T1).*

T1 went on to say:

*This is a contrasting view to the male student who will take a project and 'just do it’. Male students think they know it all and find out later they need to retrace what they have done (T1).*

This point is outlined in the theme gender and Technology and has emerged as a factor which is analysed in that section.

### 5.2.4.1 Analysis

In analysing these results in relation to motivation and what the teacher said, it can be argued that the teacher’s beliefs are that good programs and tasks should drive success in the class and in turn a student’s willingness to engage. This would appear to be in conflict with research by Pintrich and Schunk (2002) who conclude that motivation driven by outcomes such as career opportunities or life skills (values) is a more realistic goal for youth than planning and programming. However, Nugent, Barker, Grandgenett and Adamchuk (2010) argue that short term interventions will excite and motivate students, encourage them to seek out additional opportunities, explore more topics and ultimately lead to improved learning.

Boe, Henriksen, Lyons, and Schreiner (2011) argue that modern day youth will utilise personal values to engage in Technology Education practices. Australian data, in line with European and American data, show that young female learners are not articulating through to maths, science, or Technology classes into STEM. In not participating in these areas, females then fail to enter the related tertiary fields (Boe, et al., 2011; Engineers Australia, 2012). Maltese and Tai (2011) argue that motivation as an achievement in the STEM areas is misguided. Educators need to provide improvements in student choices, particularly in Science and Maths in high schools. Motivation that comes from youth should be related to a growing interest in the STEM areas rather than increasing enrolment numbers and achievement gains.

### 5.2.4.2 Results

What T1 saw as motivating his students was not always what the students saw and certainly not an expression of what the female student saw as her motivation to engage in Technology Education. S1 did not value the letter box as an artefact when she stated,

*What do I need a letterbox for? (S1)*
S1 is a student from Hong Kong in a living situation that is not standard to Australian youth and yet the program provided by the school and the teacher had channelled her into an artefact making activity that appeared to have no relevance to her. T1 saw the relevance of the skills in terms of the development of the student, however, S1 failed to understand the relevance of the skills component until having engaged in the course for a number of months. Maturation had occurred for the learner in the learning environment.

The following examines the peer support for the female student from the teacher’s perspective.

5.2.5 Role modelling and peer support

Role modelling and peer support as a theme emerged as significant in relation to measures of trust and risk taking within the classroom ecology and the support that the female student looked for in the workshop environment. It is important for moral support, having that confidant to associate with during the class. The topics which emerged and will be discussed in terms of results and analysis are peer support and social networks that come from friendships and support.

5.2.5.1 Results

Peer support was not a topic which T1 saw as relevant to S1’s learning, as stated in the interview. T1 recognised the relationship/friendship that the female student had with one male student. This student is identified as S1’s key male supporter. T1 did not see the value in S1 having or requiring support from this student. The teacher did not view the student’s friendship or link as a positive one. T1 saw no value in how the male student could contribute to the female student’s place or her achievement in the Technology class. Referring to the male student:

*The other boy ‘needs to listen’ and follow [the] brief. It’s probably easier if you do it that way (T1) to (S1) I want to do it... you will have to rethink it... we have taken some photos..... yeh.*

T1 appeared to ‘buy into’ the interactions and ideas related to S1 as evidenced in the interactions above.

The students were all new to Year 11. None had done Technology Studies as a subject before as senior school courses such as this course commenced in the post compulsory Year 11 year of school. The start of the academic year in the state of Queensland is February. The data collection commenced in March. Many, though not all, of the boys in the Technology Studies class, had taken some Technology classes in Years 8 to 10. Most of the students, who had been with the school long term, had been part of the compulsory junior school courses. Most of the male students knew each other from co-curricular school activities and there appeared to be
existing friendship and support networks. Tentatively forming working friendships was a key factor in the social network of all the students early in the term. Finding a place both physically and socially was of significance to a relatively new female student in the school and in the subject area.

A social network appeared to be very important for the female student (S1). Being the only female did make a difference to how she viewed her place in the class, as indicated in her revealing comment below:

*A class of all boys and me* (S1).

During the length of the data collection for this study, S1 and her male peer worked at the same bench and remained together as much as possible. Like the female student, the male peer supporter was participating in this one Technology class and not two or three Technology classes as the other male students in the class were. A mutual trust existed between the two students. They shared ideas and assisted one another as per the observation notes.

As S1 worked on the artefact, she either asked the male student working on her bench to assist her or resorted to the teacher for support. I asked the teacher about coming to the class on a particular day. He said:

*She (S1) always feels special to have you come along to the class* (T1).

Toward the end of the study, I observed that the female student was happy when I offered to assist in holding her artefact while she attached it to the vice or got the drill. Apart from the teacher and the one peer supporter, she did not ask the male students for assistance on her artefacts. At times, they did get things for her. She deliberated out loud one day toward the end of term 2:

*I think I will have to drill this hole in the letter box* (S1).

A drill arrived on the bench immediately. This was the first time I observed another male student actively assisting S1 in the workshop.

The following analyses the peer support from the perspective of the teacher.

**5.2.5.2 Analysis**

The teacher saw his support as that which would assist the female student most. T1 did not appear to recognise the mentor value and peer-support that could come from another student. The male peer supporter had similar hand skills and knowledge levels in Technology as did S1.

The female student did rely on support from one particular individual within the workshop. Observations showed that initially the support appeared to come mostly from her male peer supporter. The support factor was important in terms of the development of a social
network. Over the course of time and once S1 was more familiar with the students in the class and the workshop it appeared that S1 was directed by the teacher and that she relied on his guidance but did chat and interact with fellow students.

Peer networks can be important factors in adolescent development (Pintrich & Schunk, 2002). Pintrich and Schunk define the network as the large group of peers with whom the student associates. They outline a number of studies which show that peer selection and socialisation goes on up to Year 12. Adolescents form dyads or triads and these are at times gender-specific.

In the studies reported by Pintrich and Schunk (2002) on peer networks, there was evidence of motivational selection and socialisation within the peer groups. Groups which formed early in the school year maintained their motivational composition even though at times members may have altered from within the peer group. “Peers who spend most time together are regarded as best friends” (Pintrich & Schunk, 2002, p. 386) and can strongly influence students to engage in certain activities. In this class S1 had formed a friendship peer group with a student of the same academic level in this subject area. The teacher did not believe that any advancement in construction skill development S1 would require to complete the class tasks would come from her male peer supporter. T1 believed the teaching would come from him as central to the learning environment.

The reliance of S1 on the male peer supporter meant that they worked in unison on their individual projects but at the same pace. When S1 was absent from the workshop she was outside in the common area with the peer supporter. The friendship which developed was regarded as a negative by the teacher and was possibly the reason why she was guided back to making a simple rectangular wooden letter box while the male student completed a clear Perspex mail box.

On one occasion, toward the end of the artefact development, S1 accepted the participant observer’s support with the assurance that she could do the task. Her willingness to take an outsiders support showed a developmental confidence in the task and in her role in the workshop. S1 demonstrated that she could attempt the skill and that she was not completely reliant on T1’s guidance to complete the task.

The final observation visit to the workshop saw S1 confidentially and competently attaching the lid to the letter box. This was an example of her growth and empowerment in the design process and of her skill development. The support from the researcher was appreciated and it appeared to be a confidence boost for her to explain to me, the researcher, what she had in mind as the next process.

The following examines the theme of socio-cultural approaches to learning from the perspective of the teacher.
5.2.6 Socio-cultural approaches to learning

Socio-cultural theory describes learning as distributed, interactive, and contextual and the result of a learner’s participation in a community of practice (Smith, 2003). The theory uses the Vygotsky belief that adults and peers influence individual learning. This impact occurs in conjunction with cultural beliefs and attitudes and collectively shapes instruction and the learning which takes place.

The following outlines the results related to the socio-cultural approaches to learning with regard to students and subjects in the case study site.

5.2.6.1 Results

The demographic catchment of students who attend the school could be a factor which shaped the decisions that the female students make and the choices they make in choosing or not choosing to participate in Technology Education. Two factors impact on females in Technology Education in this school. Firstly, the timetable, the practice of subject selection channelled females into Technology Education, Fashion design or Home economics. They are three similar, but competing subjects. The male students all agreed that there should be more females doing Technology but:

*They [the female students] like Fashion Design better* (a statement made by one male student in a group of male students interviewed from S1’s class).

The second factor which appeared to shape female students’ decisions about selecting Technology Studies is what is defined here as the future view. This is the socio-cultural view for females who may look at entering Technology Education subjects. This rather surprising view appears to come from the parent community and was captured by a question from a male student below:

*Where did this subject lead to for girls?* (Male student interviewed).

Male students tended to take a number of Technology related subjects. Some mixed Technology Studies with Physics. Seven of the fourteen male students in the class did trade certificate courses and Technology Studies. All the male students appeared to have a fairly clear and coherent reason for being in the class. One boy told me he was inspired by projects he had seen year 12’s working on when he was in the junior years. It was his ambition to be one of those year 12’s completing his project. The junior school female students did come into the Technology building but there appears to be a question mark concerning their responses to the projects, specifically, do they see them in the same light as the younger male students.
T1 did not believe that there was any real difference between the learning styles of females and the males. This opinion was expressed in both his written feedback and in the interview. He wrote:

*The qualities of a successful female student included attention to detail, thoroughness and taking advice from the teacher on board.*

*This is a contrasting view to the male student who will take a project and ‘just do it’. Male students think they know it all and find out later they need to retrace what they have done* (T1).

The teacher noted feedback from previous Year 12’s that a successful classroom was one that motivated learning. He said;

*I have to say I want kids to be successful- with fewer projects we can steer them* (T1).

T1 reported that STEM subjects were perceived as constituting a male-dominated field. T1 did not believe that females taking Science studies were any more encouraged to engage in Technology Studies (Interview schedule T1).

Socio-cultural approaches to learning and instruction recognise and empower linguistically and culturally diverse students. Socio-cultural theory (John-Steiner & Mahon, 1996) describes learning as distributed, interactive, contextual and the result of a learners participation in a community of practice. It is the collaboration of thinking that results from these processes which opens up access to greater thought processes. In uncovering the silence of women we alter the social landscape (Belenky et al., 1986). Biljker (1995) argues that learning within a techno-social sphere may be the best environment for females.

The following outlines the analysis in conjunction with socio-cultural approaches to learning from the teacher’s perspective.

Given the low number of females participating in Technology Education in this site the socio-cultural influence on female participation appears to be a strong factor in why female students are not joining into what appears to be a supportive learning environment. This was being addressed.

The presence of two female teachers in training in the junior school classes was noticed by the senior students in the class that was being observed. The presence of female Technology teachers is interpreted as lowering the gender barriers that the female students perceived existed. There appeared to be a gendered view from the teacher that was likely to impact on the female students output as indicated in the comment:

*The boys just do it – boys know it all* (T1).
In expressing this view T1 is reinforcing that the boys have an automatic function in the workshop and that the girls will need to rely on others. Zuga writes of the empowerment of females when she writes,

… need to bridge the common polarization of social theory between metaphor and materiality. Technology must be understood as part of the social fabric that holds society together; it is never merely technical or social….. (Zuga, 2004, p. 106).

In adopting a socio-cultural feminist constructionist stance, this thesis sees gender as a construct that is not created by nature as a result of biology but rather created by and contingent on social and historical processes as expressed by Oldenziel (2003) and Stanley (1993).

The socio-cultural factor which appears to influence subject choices is what females and their families view as the potential flow on from Technology Education subjects.

More females are ‘doing Graphics’ and see this as the lead into architecture (H1).

T1 suggested that if there were a broadening of information around Technology then Technology Education may increase its female intake. Knowing where the subjects lead such as into university and outside courses, trades and life skills should make it relevant.

Blewitt (2006) writing on the ecology of learning talks of the notion of creating reality and adapting critical freedom can be the filter through which we interpret new experiences. Blewitt writes that we must be aware of the processes through which we make meaning (2006). Whilst Blewitt focussed his work on media and its impact it is the notion of culture jamming and pressure on individuals that he claims needs to be changed in a learning ecology. The tactic of culture jamming aims to get a message across that is part of a social movement. Individuals will align themselves with like groups for support but it is the communicated message which has the greatest influence on youth.

The final discussion topic in the teacher interview was STEM. T1 did not know what this stood for but as the acronym was explained he was familiar with the term. He noted Technology as perceived as a male dominated field, but did not really see how this could be easily changed. When asked about Science and females in the school, the teacher did not believe this impacted on their Department and deferred to the HOD (H1) for any further in depth analysis.

From a socio-cultural perspective, T1 felt there did not appear to be any rationale for changing the projects students were given to design and produce. As a teacher T1’s manner was accommodating, his teaching style followed the steps of demonstrate, discuss, experiment and construct as a routine method. T1 did not always articulate the process during observation but did remind students of the steps within the sections they were working on. In the design room students were to draw within the dimensions, use a number of skills and keep in mind what the
outcome of the project would be. He was encouraging and kept very busy monitoring the various stages of the projects which students were working on.

There was a lack of acknowledgement by T1 that the projects, the subject department, or the school needed to alter to be more accommodating of females in order to encourage more girls into Technology Education.

The following examines the values aspect of why female students in this context may have chosen to take Technology studies and how they are encouraged.

### 5.2.7 Values and Technology Education

Values is the seventh and final theme which emerged. Values referred to in the study include those values which people hold and are motivated by, as expressed by Rothschild (1988). Values drive how one functions and tend to stem from one intrinsic motivation. The results and analysis section examines values related to sustainability and motivation.

#### 5.2.7.1 Results

When interviewing the teacher (T1) about values he asked for an explanation of what it meant. Concepts which related to sustainability and materials choices were noted:

*It is not a topic we really talk about. There is a choice of materials and students select according to the project.*

*Yes it could be sustainability (interview schedule T1).*

S1 did not have the history or a background of engaging in resistant materials as part of her previous Technology studies. Her hand skill development in the subject area of Technology Education as reported by T1 and the HOD was limited.

*She [S1] was ‘allocated; the subject as against choosing it’ (H1).*

The school encouraged her to make the decision to take the subject. S1 decided to take the class because she wanted to *‘try something new’*.

The motivation for S1 in taking on the challenge of resistant materials Technology was that she would receive support from the staff. An intrinsic developmental value rather than a terminal value to use the subject as a means for a career or employment readiness in the future. The assurance of support could be viewed as an extrinsic motivator.

The teacher’s opinion was:

*She will develop the skills which will lead her into Year 12 with some experience (T1).*

Towards the end of the research period which was the end of the letterbox unit S1 was more self-directed and confident in what she was doing. Her project progressed and the clarity about what she was doing and needed to find was evident.
The following provides the analysis for values and Technology Education as they related to sustainability and motivation that stemmed from values.

5.2.7.2 Analysis

Early observations were that S1 was not initially motivated to engage in the Technology Education class. The factors which illustrated this were her uncertainty of voice and position in the class. The lack of motivation or the ability to develop the mastery to achieve at the performance level stemmed from her not valuing the content. The self-motivation to achieve did not come from a goal setting motivational process that Pintrich and Schunk (2002) suggest would lead to a sense of self-efficacy.

Exercises such as goal setting at a group and then individual level could in turn sustain motivation and develop skills. Students with positive role models of goal setting will aim for higher goals which in a classroom setting evolved from students seeing or hearing others. A second goal is the reward structure (Pintirch & Schunk, 2002). Students take classes in order to achieve top grades that will take them onto further education or careers. This is not why S1 chose the Technology class. The extrinsic motivation in a long term course, coupled with artefacts which S1 did not value led to her undervaluing the class.

The early visits to the room saw S1 avoid some of the demonstrations and spend time with her peer supporter rather than working in the class. S1 did not have the confidence or skills to compete and was isolated in terms of interaction with other long term Technology students. As a learner S1 relied on the teacher and his support to enable her to succeed.

The teacher talked about motivation early in the school year. The notion of self-motivated students did not pervade or seem to be promoted in the classroom over the length of time the researcher visited. The female student spent time outside the classroom. This was not through her being disciplined but more so through the options that the students were provided with. They could choose to be outside. One could observe that being outside often meant being off task. At times S1 was told to re-join the class and she did so for demonstrations. S1 missed several teachable moments when T1 simply stopped the group in the workshop to provide a quick lesson or skill revision as it came up on a job.

5.2.7.3 Summary T1 - Case Study 1

This section has examined the results and provided an analysis of the teacher in Case Study 1.

The focus for the Technology Department in the school was the ‘take-home-ability of products’. This meant the artefacts had to have family and parent appeal, in the words of the HOD. This concept translated into the projects which the students worked on in the Year 11 class.
Chapter 5. Case Study 1

The second and significant outcome is that the staff in the Technology department believed they were working in a gender neutral curriculum. Brunner (1997) and Paechter (2007) argue that no matter how good the programming or how robust the planning this is not a viable practice. There is a need for female oriented pedagogy. This same type of pedagogy will also suit some males and their learning styles.

In this case study, there is a good awareness of teaching the concept of higher order thinking. The structure of the learning is a motivational factor for students in Technology Education and this worked within the structured lessons provided by T1. Technology research from Europe and the United States (Murphy, 2007 in Dakers & Dow, 2009) report that it is difficult to overcome stereotypical values on the part of parents and teachers. This study has demonstrated that students, in very limited numbers to date, can overcome some historic stereotypes however it is the teachers and the programs which appear to be some of the limiting factors.

The following provides the female student’s perspective across the seven research themes.

5.3 Case Study 1 - The female student (S1)

The following section presents the data, analyses the written interview schedule, observations and conversations with the Year 11 female student in the Technology Studies class.

The data, as for each section was analysed through four data sets. These included: interviews, observation data, recordings, and photographs. The interviews included conversations with the students, the teachers in each of the case studies and the HOD along with comments from the Deputy Principal.

5.3.1 Student S1

The researcher met the student (S1) on the first visit to the school (March 2013) in a Technology Studies class where she was the only female in a class of 19. The class had a male teacher (T1). The student was a female Year 11 boarder in a private co-educational school in Brisbane. She was close to 18 years of age, from Hong Kong having been educated there until the year prior to this study.

S1 was studying Maths A, Modern History, English and had changed from Graphics, and Fashion. She saw this as a fun subject. These are the same words Year 10 females had used when I visited that class.

The following section outlines the results and analysis of the learning ecologies in relation to the female student in the learning context.
5.3.2 Learning Ecology

The results for learning ecology emerged in terms of six themes. These comprise: facilities for technology; prior engagement and familiarity with the environment; growing confidence; safety and security; and support for learning from others.

5.3.2.1 Results

5.3.2.2 Facilities and the learning ecology

Over the course of the study the student became a part of the learning environment interacting with participants and moving from outsider to member through her familiarity with a number of factors which surrounded her. Initially the student was not familiar with the environment.

In terms of a learning ecology, the Technology workshop had good facilities in terms of equipment and work spaces for students to work at. The general environment of the workshop was purpose designed for Technology Studies in a multi-purpose industrial style modern building with Technology and Design occupying the first two floors. There was flexible space in common areas and storage available for student projects and resources as well as equipment.

While there were a large number of students in the class, the female student was located at a bench close to the front bench where the teacher based himself in the early part of the lessons. In terms of student placement, this is close to where she worked all term. T1 rarely stayed there in preference for circulating the room and giving demonstrations in a variety of locations depending on the machine being used at the time. In terms of a learning ecology the students could co-locate at the benches, in groups, but appeared to work independently despite standing together. Most equipment was located close to where the students worked at the benches. It was a well-resourced tool rich environment.

5.3.2.3 Prior engagement results

When asked what she had done prior to this subject in Technology she said in Grade 9 it was computers but the classes were very different to this school. In asking her why she had selected this subject she replied: To try something new (S1).

S1’s initial choice of electing to take this Technology class indicated that she was prepared to be a risk taker within what was a supportive learning ecology. She was provided with undertakings by the HOD and the teacher that she would be given support in the class. Weber and Custer (2005) note that both genders enter Technology Education courses with preconceived notions about the types of activities in which they will engage. As they suggest, there needs to be further research and development to better understand the dynamics of student preferences for Technology related topics, activities and pedagogical approaches in order to appeal to both genders.
Factors which affected S1’s choice of this subject can be seen in her words; *To learn something new*. The first time the researcher asked this question as to why she chose Technology Education she replied:

*I had looked for a different subject area.* (S1)

S1 did not see herself as a traditional girl who would do fashion design, and when she was offered this subject by the school, she took up the option. When asked, early in the study, would she use what she was learning later on she shrugged: *Dunno* [don’t know](S1).

### 5.3.2.4 Familiarity with the environment

S1 was hesitant about a stranger being in the room and reticent about someone from outside being present. The teacher introduced me by way of:

*This is Vicki she is here to see what you do* (T1).

S1 was short in her replies and needed to participate in the class so the researcher circulated looking at what others in the class were doing. At the time I was introduced to the class S1 was new to the learning area. When asked the same question at the conclusion of the research study she replied:

*I do not see myself using this subject. I am heading towards a Bachelor of Arts study. But I have learned some valuable skills.* (S1)

### 5.3.2.5 Growing confidence

It was observed that S1 changed in attitude during the course of the research. Once she became familiar with the location and the presence of the researcher she was able to express herself more in the workshop. She remained cautious in what she did but appeared to function in what could be interpreted as a supportive environment.

The concept of being in a majority boy’s class did appear to worry S1 at the start of the year but was less of a concern later. It appeared that S1 was still finding her grounding in the workshop setting when I first visited. The initial visits to this class saw each individual in the class constructing an LED light using metal, plastics or timber. Each student was to have a purpose for the artefact. Some boys said it was for their desk, others said it would have a place in the lounge room and their mothers were looking forward to seeing them.

### 5.3.2.6 Issues of safety and security

S1 reported that she saw the Technology workshop space as very safe. This was partly because all the students had to *‘wear goggles and aprons’* but also because she appeared to have her own space to work in. Her sharing was with her male supporter and with T1. Her socialisation fears had dissipated by the end of term 2 and she appeared to have adapted to the industrial
learning ecology as well as the notion of the produced items. She appeared pleased with her LED light and this initial success seemed to assist in her finding a place in the class and feeling secure.

5.3.2.7 Support for learning from others

When questioned about the classroom environment, the female student stated she was in a class of all boys and just her. As discussed earlier, the notion of gender isolation did appear to worry S1 at the start of the year but was less of a concern later. The second and subsequent visits to the workshop saw the student located on the opposite side front desk. Her peer supporter co-located where ever she was. There appeared to be a strong relationship between the two students but it was difficult to see who was the stronger. The peer supporter would at times reply to a question when the researcher asked S1 and she would nod in agreement. The peer support student reported that his focus was the Arts and he had taken this subject in order to learn skills that would be useful in drama and other pursuits.

5.3.2.8 Analysis

The following provides the analysis for the learning ecology as related to S1 under the following topics: Facilities and the learning ecology, prior engagement in Technology Education, growing familiarity with the learning environment, issues of safety and security and support for learning from others.

5.3.2.9 Facilities and the ecology

By the definition of learning ecologies, they are supportive environments for learners. S1 was unsure of what support she had early in the research and her location was to be near the teacher’s front bench. The analysis of the physical environment suggests in this respect, there was a positive learning environment in that all students, including S1 had sufficient equipment and space to learn. Petrina (2007) argues that Technology studies, more than any other subject requires environmental and ergonomic conditions that need attention for the subject area in order for students to function and learn.

Dakers (2007) would argue that in order to encourage more females into these learning ecologies there is a need to build familiarity with the industrial setting and how females will operate within that ecological environment. This would overcome the apparent lack of familiarity the student had in the environment early in the course.

S1 appeared shy in the ‘industrial style’ educational setting and with a stranger, in terms of the researcher, focussing on her alone. Her discomfort at the start of the year appeared to be about the setting as much as the researcher. This can be interpreted as her lack of familiarity with the setting and its facilities. Her attitude and demeanour altered over the course of the
research study to one of greater confidence in the learning environment and with the people in the setting. It can be argued that as her familiarity with the learning ecology grew so too did her ability to fit into the class and be recognised as a learner in that environment.

Learning in a community that is a student centred, social constructionist style may encourage teens to engage and grow. Pintrich and Schunk (2002, p. 153) argue that “a knowledge of the factors which characterise these ecologies may assist teachers and administrators to examine current practice and learning environments and engage more students”. Understanding the social aspect to learning and student led decisions around what projects the female students wish to engage in may provide long term benefits.

5.3.2.10 Prior engagement

It can be interpreted that S1 was a risk taker whose life experience showed that she was prepared to engage in learning which she had not undertaken before in this context. Furthermore, her comment about future studies: *Dunno* (S1) suggests she is unsure or ambivalent about the possibilities of the area for both future learning or employment options.

To encourage more female participation, there needs to be a balance between those selecting the class to fill timetable gaps as against those will take the class for career prospects. Technology departments should be marketing the career and skills opportunities to females in the earliest years of high school well ahead of the girls having to make subject choices. As Williams (2009) argues, there needs to be a commonality in diversity of teacher education and qualification courses in order that school programs can provide authenticity as part of teacher professional activities.

5.3.2.11 Growing familiarity with the learning environment

The change in S1’s confidence is interpreted as coming from three factors: Firstly, her maturation as a student has to be one factor. Secondly, she was becoming more comfortable and familiar with the learning environment; and lastly, S1 had encountered success in the learning environment. Marra, Rodgers, Shein and Bogue (2009) talk of the positive outcomes from small achievements which enable students to take on greater challenges in the next learning encounter.

As Eckert and McConnell-Ginet (2003) highlight, gender is an achievement that one does. It is a set of practices through which we construct and claim identity and maintain social relationships. As S1 grew in confidence, she regained her gendered construct to have a legitimate place in the class. Her place was less about voice than it was about respect within the learning community.
5.3.2.12 Issues of safety and security

Finally, in analysing issues of safety and security S1 verbalised these as the glasses and the aprons the students wore she referred to the larger caring environment in which the students worked. Her bigger picture (world view) covered the health and safety risk factors that students were aware of that added to the notion of safety. Belenky et al. (1986) would suggest that this notion reflects the patriarchy of learning under the male teacher’s protection and direction but seen from a woman’s perspective. In preferring to work with others, she believed she could get help when it was needed. John-Steiner and Mahn (1996), writing in relation to the Vygotskian notion of activity theory, say that learning is a social phenomenon. It is social practice that is the construct of a particular group stemming from humans being social beings and one which requires constant reaffirmation in order to maintain the dynamic process where people interpret reality and knowledge.

5.3.2.13 Summary

In terms of the workshop setting, S1 did not mention the use of machines around the room. Rarely did I observe her using any during the visits to the workshop. S1 stated she preferred to learn by working with others as she was new to the subject. Wajcman (1991) claims that not only do females use space differently but they approach the designed world in different manners as much as they have vastly different ways of looking at ideology and culture. “Invariably technologies that are dominated by men conspire to diminish the significance of female technologies which in turn reproduces the stereotypical view of women in this field” (Wajcman, 1991, p. 137). When very small numbers of girls are placed in classes of overwhelmingly occupied by boys, they will and do see the learning process differently to that of the boys.

5.3.3 Gender and Technology Education

The results for gender and Technology were found to be feminist approaches to learning, engagement in the process and gender resilience.

S1 was well aware that she was one girl amongst 18 male students. She did acknowledge in the final interview that the teacher and others supported her. The student stated her preference for having a male teacher. She preferred a male teacher as

He gives me a lot of attention as he knows I am new to the subject (S1, July).

A feminist approach to learning was observed during some of the construction phases. S1 was hesitant to progress small elements of her projects until she had the approval of the teacher to continue with what she was doing. This behaviour appears to be consistent with hierarchical gendered approval model but contrary to a feminist decision making ideal. The teacher appeared to make some key decisions for her. Many of these decisions seemed to
happen between the researcher visits to the class. Towards the end of the second term, the final visits to the class S1 called on her peer supporter in the workshop to do the tasks she was not willing to take a risk on.

S1 was observed not engaging in the learning processes. Several times S1 had absented herself from a workshop demonstration in preference for being outside in the common area. Possibly she knew the teacher would assist her to complete her task regardless of her needing to see it demonstrated. The day S1 was fitting the letter box flap she had to pre-drill the holes to insert very small screws onto a space in order to attach the swinging flap. S1 appealed to her peer supporter several times. He stopped his work to help her. When neither of the two students could position the very small screws into place she looked for other assistance. It was suggested she could ask someone else which she did. S1 then asked others to come and assist which they did this in response to her request.

The researcher observed that S1 grew in confidence over the four months of class visits. Informal discussions with the teacher confirmed the observation that she had grown in confidence in the workshop environment over the period of time of the study. S1 worked alone when her peer supporter was absent. She would reach a point in her artefact making where she was unsure and would wait for the teacher’s approval before progressing. A gendered response to the situation was: stopping, waiting, and gaining approval before moving to the next task in the project. Given the time restraints of the teaching program this ensured the job would be correct and attempted once to ensure success. This lock step process did not appear to allow for experimentation through constructionist learning in an experimental environment. Belenky, Clinchy, Goldberger and Tarule (1986) would argue that she had mastered the masculine mode in order to succeed.

5.3.3.1 Gender reliance

During the construction phases, S1 made few attempts to find the teacher when she needed him to progress a task she did not have the skill to do. S1 used a gendered reliance technique under the assurance, made to her, that she would receive support when necessary. This meant that she did not have to compete for attention in the class to complete the task. During the student interview, S1 was asked to explain what she liked about the subject and what she was doing in the Technology class.

\[ \text{It’s fun, challenging and rewarding. I enjoy making my own designs because they are usually different from the boys (S1).} \]

When S1 was asked; would you recommend Technology Studies to your sibling or friend? Why/ why not?

\[ \text{Definitely, it’s a class where you use/ learn many different skills to discover new things (S1).} \]
In reply to the question about how she saw her designs as different, she explained:

_Aesthetically appealing (S1)._ 

The following analyses gender and Technology Education through examining feminist approaches to learning, engagement in the process and gender reliance.

### 5.3.3.2 Analysis

In terms of analysing feminist approaches to learning the feminist method proposed by Blackmore (1999) and the feminist critiques of Lerman et al. (2003), Hesse-Biber (2010) and Oldenziel (2003), all note that there are differences in boys learning as against girls and that we cannot presume that both genders will ‘naturally’ like certain things nor use the same approaches to how they will learn. While the teacher reported that female learners are better at project managing and taking small steps to get tasks completed in a timely fashion, S1 did not appear to grasp the production phases of the letterbox. She had a planned outcome but did not appear to be aware of the necessity of joiners or fasteners.

The different style of learning of the female student, needed to be addressed by the teacher. S1 understood a lock step process for what she was to do to complete the artefact but not the reasons for using particular tools or processes to reach the end point. This would appear to be a time and experience issue for a learner new to this learning context.

S1 had missed some of the teaching demonstrations through not being present in the workshop. She appeared to have made the choice not to engage in the process. Two possible reasons may explain this. Possibly she knew the teacher would assist her to complete her task whether she saw the demonstration or not. Her decision to be absent when the whole group of boys gathered together could have been made due to her self-consciousness about being the only female. The female voice was at times missing from the classroom and the workshop. The issue of language is discussed in the next theme and the issue of having a voice is important to the analysis.

There was a gender bias in terms of support. From the researcher’s understanding of the timetable, the teacher’s support was assured. S1 was not concerned about her timeframe to complete the task as she knew she would receive the teacher’s support. This study has termed this her gender reliance. Williams and Williams (1996) noted points of good practice in educating young women in technology. What is important is to understand the dynamics of student preferences for Technology and related subjects and pedagogical approaches and topics that are relevant for female students. Research by Brunner (1997), Jacobs and Becker (1997), McIntosh (1983), Rosser (1988) and Zuga (1999) have shown that there are instructional methods, learning styles and interests that can be characterised as distinctly female. Weber and Custer (2005) argue that when Technology teachers adjust approaches and programs to better
understand student preferences for Technology and related topics, activities and approaches then they will appeal to a larger range of students.

The following theme extends on the learning ecology and examines language use in the classroom.

## 5.3.4 Language use in the classroom

The following examines language use in the classroom under the themes of: terminology; checking for understanding; and having a voice.

### 5.3.4.1 Results

### 5.3.4.2 Terminology

Results of the use of language related to terminology showed there were times when the default language, inferring the commonly used terms, to address the class was ‘guys’ or ‘gentlemen’. As a follow up - ‘and lady’ would be added to the address to the class after a pause. As participant observer there were issues of language while in the class. Selective perception where what is seen as usual can go unnoticed. The audio tapes recorded subject and task specific dialogue. For the most part, students in the workshops worked with a minimum of dialogue due to the noise of the extract air fans and the radio all on at the one time in a lesson. Students responded when asked questions or went to the common area to have a discussion away from the general noise. The view of the teacher and the department was that they were operating in a ‘gender neutral environment’ follows that they believed they were using ‘gender neutral language’.

### 5.3.4.3 Checking for understanding

Many technical terms were used in the design room when the projects were being planned and drawn up. The teacher spent time explaining the task and drawing up ‘the net’ so students could work from the example provided. The teacher in one example of demonstrating the use of metal cutting tools explained the terminology needed to the whole class (Case Study 1, T1). T1 took the time to question generally and know that some students had a general understanding of the use of these tools. He did not question the female student about her understanding of the cutting tools.

During an interview, three male and the one female student were asked about some of the technical and Technology terms they used in the class. No one could explain to the researcher what the word ‘artefact’ meant. This was not a term which seemed to be used.

The female student rarely answered a question in the demonstrations I was present for. A male voice would answer for her. This was accepted as the norm. It did not draw attention to
S1 and she appeared to be happy that the question was answered and there was little focus on her.

In terms of having a voice in the workshop, the female student looked for someone else to answer the technical questions she was being asked. When S1 was asked about her job/project she would look for her peer supporter to answer for her. At times, she felt self-conscious about the questions. S1 responded when the teacher addressed her independently, and she asked questions as he circulated the room. S1 did not hesitate to respond to personal questions asked of her. On more than one occasion her male supporter did answer for her. This supports the concept of silence that Spender (1980) highlights as a patriarchal order in a male supremacist society where the language of females is devalued.

5.3.4.4 Analysis

In analysing language use in the classroom, terminology, checking for understanding and having a voice were the three areas related to the results reported above.

Spender claims that the ‘default language’ is so embedded that no one notices its use (1980). Terminology and the use of accepted language was so embedded that the HOD and the teachers believed that they were exercising ‘gender neutral language’ when in reality it was quite the opposite. H1’s claim accords with Spender (1980) who argues that there is a power interaction which may be seen as a natural occurrence between the sexes.

In his demonstrations, the teacher did not check for understanding by questioning the female student. He was aware that she would not want to stand out to the class members. Not knowing the terminology, it is presumed, was due to S1’s recent induction into the class. The boys, many having participated in various levels of Technology activities in other years understood most of the terminology used by the teacher in his demonstrations. They could articulate most terms however, none knew what the word artefact meant.

The group did not see that there were any gender issues in the course excepting that more girls should do the course. It appeared that the students did not understand the notion of gendered language nor the gendered voice that was not being exercised in the classroom.

5.3.4.5 Having a voice

It would appear that S1 lacked a voice in the general learning environment. S1’s lack of response could be due to the mode of dialogue and her uncertainty of the terminology in use in the Technology environment. Her not wanting to be seen to declare a wrong answer in amongst her male peers is interpreted as the lack of voice in what should be a supported and supportive learning ecology. Constructivists make a distinction between ‘really talking’ and which they consider to be didactic talk in which the speaker’s intention is to hold forth rather than to share ideas (Belenky, 1986). In didactic talk, each participant may report experience but there is no
attempt to join together to arrive at a new understanding (Belenky, 1986). *Real talk reaches deep into the participant, implies a shared agreement and creates a setting for emergent ideas to grow.* This was not the classroom banter. *Conversation, as per constructivists, includes discourse, exploration, talking and listening, questions, argument, speculation and sharing* (p. 144). The female was put in the position of choosing between speaking or listening but not being engaged in dialogue in this setting.

### 5.3.5 Motivation

The results for motivation fall into three areas. Firstly, the specialty factor related to the subject area, secondly, the gendered performance factor and finally, the change and growth in confidence.

#### 5.3.5.1 Results

#### 5.3.5.2 Specialty factor

S1 declared she took the Technology Education subject as ‘something new’. She had looked to do ‘something different’ in terms of a subject and Technology Studies fitted into her timetable. S1 did not make a career choice in selecting this subject but rather a personal interest choice.

S1 declared she did learn skills and enjoyed constructing her own designs. The LED light and the plan for the turtle letter box were different from the plans of the boys in the class. S1 saw them as ‘artistically appealing’. When asked what she liked about the subject:

> *It is fun, challenging and relaxing (S1).*

Her motivation for taking the class was not the same as for many of the boys in the class as she had discussed earlier. She was looking for something different.

#### 5.3.5.3 Gendered performance factor

The second performance factor was that S1 was very aware of being the ‘only female’. During the early visits to the class S1 prefaced what she was saying with; *I am the only girl.* There was an adolescent need to ensure that she had found her place in the class. This is difficult to separate from the gendered voice discussed earlier. S1 needed social time to find if she was accepted in the Technology workshop environment. Her initial motivation was to find a place rather than competing to finish a product using skills she was uncertain of.

#### 5.3.5.4 Changing confidence

Over the length of time of visiting the class S1 did gain confidence in what she was doing. She stayed close to her main peer supporter. It appeared that she did not wish to stand out amongst the others. She seemed to gain motivation as time progressed.
5.3.5.5 Analysis

The analysis for motivation falls into the areas listed. Firstly, the specialty factor related to the subject area, secondly, the gendered performance factor and finally, the change and growth in confidence.

The point of difference and S1’s responses in the learning environment can be explained by the motivational factors which she declared early in the semester. Her motivation altered as the terms progressed.

5.3.5.6 Specialty factor

It is interpreted that in S1 choosing to ‘do something new and not as a career choice’ may have lowered some of S1’s motivation to perform in the class. The lack of competition and lack of drive to excel meant that she at times appeared unmotivated. Taking herself outside of the workshop in order to sit and chat with her peer again did not show a dedication to the class or effective use of class time.

In ‘choosing something different’ S1 was motivated by the specialised nature of the subject necessitated by performance expectations which encouraged her to step outside a traditional gendered role that is part of the traditional school setting that was Case Study 1. The definition of motivation, as provided by Pintrich and Schunk (2002), is that it is a process whereby goal-directed activity is instigated and sustained. Rokeach (2008) argues that values have a motivational function to guide human activity in daily situations with their longer term function of providing expression to basic human needs. Values will be discussed further under that theme.

S1 had, by the end of the research, period seen the long term benefits that the subject could offer her with regard to life skills. The greater understanding could come from the teacher articulating to her the project management skills as well as higher order analysis skills of problem solving that would enable her to solve this and other tasks.

5.3.5.7 Gendered performance

S1 knew that she had support to succeed in the class and that she was capable of exercising a course of action which would assist her in that non-traditional setting. The support of T1 gave her a degree of assurance and meant that she would maintain a place in the class. In being part of this environment and having developed a social circle, albeit small, S1 was provided with encouragement to persist and sustain her efforts in technology. Marra, Rodgers, Shein and Bogue (2009) examined the positive outcomes from learning that develop from student satisfaction. S1 was content to be working on the wooden letter box at her ability level at the end of term 2. One can conclude that her performance levels had altered with her greater understanding of the course, its content and thus her motivation to engage.
5.3.5.8 Change and growth in confidence

The confidence which S1 gained over the research period showed in her self-direction and her ability to articulate what she was doing towards the end of the two projects. Klapwijk and Rommes (2009) speak of motivation and values as career anchors. A career aspiration was not what S1 reported as a priority for her learning. She did exercise degrees of self-efficacy as she became more confident in the learning environment. Her success in achieving some of the tasks appeared to have a flow on effect to her positive attitudes towards the Technology class.

The following discusses the results and analysis of peer support in relation to the female student.

5.3.6 Role modelling and peer support

Results for role modelling and peer support were examined through the themes of learning preferences; paired work; skill demonstrations and self-consciousness versus skills.

5.3.6.1 Results

5.3.6.2 Learning preferences

Who do you choose to work with in Technology? This question was put to the female student by the observer. The response:

My friends, I prefer working in pairs. It is much easier to agree on things, communicate, and get the job done faster (S1).

S1 had a male peer supporter, a significant person to the female student. She relied on him not for skills or knowledge but to discuss ideas that were part of her design process. As noted in the teacher section (5.2), T1 did not see this student as important to the female student. The preference of S1 for working with someone was clear.

Observations confirm the response from the student that her learning preference was to work with someone else. In working closely with her peer supporter she did communicate with him though at times he did not have the technical answers she required. The teacher seemed to have some dislike for the male student who was the peer supporter of S1.

5.3.6.3 Paired work

Both students (S1 and her peer supporter) were new to this learning area. Both students took Technology Studies as the one single subject in this area and neither was familiar with the surrounds and artefacts (tools) as the majority of students around them were. During one short interview the peer supporter answered questions for the female student. She did not contradict what he was reporting. They interchanged places working on each other’s design tasks. When one left the room to go outside into the common area the other followed. This happened on a
number of occasions. T1 did not stop the pair from working together or going outside together but showed his disapproval. On one occasion, he brought them back inside where they were able to sit at the front of the room.

5.3.6.4 Skill demonstrations

The last observation workshop visit saw S1 applying herself to constructing the letter box and trialling skills before applying them to the actual artefact. This was the most applied work that was observed over the course of the study. Her peer supporter was working on his perspex letter box and S1 was focused on her task. If she could not find what was needed she would ask and one of the nearby boys would locate the item for her or would suggest where to look.

   The role model the student looked to, in terms of learning skills she needed, was the teacher. S1 relied more on the teacher directing the task over the course of the two terms rather than her watching his in class demonstrations or modelling of skills to complete a set task.

5.3.6.5 Role model to self-internalisation

S1 would move from the demonstration desk back to her project and continue with her own task. The first example observed was an afternoon lesson with the LED light under construction. The teacher demonstrated the soldering of a rocker switch. S1 did not rush to the demonstration bench nor take a prime position. Her self-consciousness at being the only female and unsure of the social setting may have had more to do with her actions. Conversations with her later and her re-iteration of being alone validated this observation.

   Despite the female student’s reliance on the peer supporter, she did not model her work on his work. S1 did follow the lead of this peer at times much to the obvious annoyance of T1.

5.3.6.6 Self-consciousness vs. skills

For S1 not standing out from the ‘crowd’ meant that at the end of the demonstration she left quickly to go back to her bench. She appeared to avoid the environment as well as the social interaction with other peers due to her apparent poor skill levels. At that stage in her LED light project, she was struggling with the design and had not reached the point where she could apply the functionality of the switching mechanism to its operation. She was falling behind in the making phase of the process.

   The following topics for role modelling and peer support were examined through: learning preferences, paired work, skill demonstrations and self-consciousness versus skills.

5.3.6.7 Analysis

The analysis for the theme of role modelling and peer support was examined through the themes of learning preferences, paired work, skill demonstrations and self-consciousness versus skills.
5.3.6.8 Learning preferences

Belenky, Clinchy, Goldberger and Tarule (1986) argue that ‘connected’ knowing is more natural to women than does a ‘separate’ knowing.

*Educators can help females develop their own authentic voices if they emphasise connection over separation, understanding and acceptance over assessment, and collaboration over debate; if they accord respect to and allow time for the knowledge that emerges from first-hand experience; if instead of imposing their own expectations and arbitrary requirements, they encourage students to evolve their own patterns of work based on problems they are pursuing. These are the lessons we have learned from listening to women’s voices.* (Belenky et. al., 1986, p. 229)

It is this important point of connected learning which was lacking in this case study. Whilst H1 and the teachers believed they were catering to all learners, in reality, they were not connecting learning to what teenage females saw as authentic projects.

T1 failed to see the importance of a confidant and the moral support this person offered as well as this friendship bolstering S1’s place in the class. Belenky, Clinchy, Goldberger and Tarule (1986) talk of connected classes where they cite the work of Freire -that the object of knowledge is not private property. The teaching, learning process should enable all participants to engage in the process of thinking and as they talk it out, it becomes public dialogue.

5.3.6.9 Paired work

Both students were at similar developmental levels in the Technology Education class. They shared peer oriented goals as described by Pintrich and Schunk (2002) which are highly valued by students. Goals may be social: to be liked, and to receive approval from others to develop intimate relationships, to co-operate with others and to win favour. Pintrich and Schunk (2002) talk of these goals conflicting at times especially in academic settings.

*Students’ perceptions of competence are affected by peers and, in turn influence their academic motivation* (p. 283).

Pintrich and Schunk (2002) argue that as students alter educational settings they must reassess their capabilities for succeeding academically. S1 had done this as the new arrival in the Technology Education class. She needed to build a new social network for this unfamiliar context. It is suggested that any student would need to build relationships in a new setting, but it was important for this isolated female to be able to build a peer network quickly in order to function in the workshop setting.

5.3.6.10 Skills demonstrations

Only during the last workshop visit did S1 and her peer supporter seem to be working independently, on their own projects. They continued to stop and share comments and ideas but
appeared to have their own directions for the lesson. It was impossible to know whether this was long term developmental progress rather than a short term goal for that lesson when the researcher was present.

The teacher appeared to be the key role model because he provided skill demonstrations to the class. Several reasons emerge as to S1’s unwillingness to attend the demonstrations provided by T1. Firstly she was not aware of the value or the role of the demonstration for learning. In not knowing this she was oblivious to the application by doing process. Secondly she was less interested in the actual demonstration. S1 appeared to know that she would be provided with specific help at a later time.

5.3.6.11  Role model to self-internalisation

Papert’s (2006) constructionism argued that “children do not get ideas, they make ideas” (Petrina, 2007, p. 178). Students are likely to make new ideas when actively involved in designing and making an artefact – a robot, a poster or computer program. It is the modelling that enables the interface between the cognitive manipulation, building and design that becomes the business of Technology educators. In this sense the modelling of the teacher and those around S1 was important.

The premise is that when students construct things in the world they simultaneously construct knowledge and theories in their mind. As they construct things in their mind they construct the world. Constructionism thus offers a key piece to learning theory. Technologies are essential to learning, not just learning about technology. (Petrina, 2006, p. 178)

Papert’s (2006) work was about the design and construction as against earlier educators such as Froebel and Montessori who believed that the environment and manipulatives programmed and stimulated intellectual thought. What Papert did not account for was technologies and social interactions in a learning environment. The lack of confidence of the female student during the first term in the workshop could have added to her discomfort in joining the ‘crowd’ at the bench. As the researcher encouraged her to gather round the demonstration bench, the teacher then made sure she understood what was being demonstrated in the process and in turn, she engaged more. Over time she appeared to become more comfortable in the learning environment. S1 did not rely on her peer for technical knowledge as she viewed his skill set as either equal to or below her own. Her reliance on the male peer support was social in terms of friendship. The male friendship, in turn appeared to give her a place in the class.
5.3.6.12  **Self-consciousness vs. skills**

When S1 was falling behind during the making phase of her first project she was at a loss to articulate how she would find the time to complete the project. She appeared not to take the time factor as a serious concern and this can be interpreted as her not understanding the nature of managing projects and fitting into select time frames, the nature of a Technology project. When questioned she shrugged and offered no explanation. Research by Pintrich and Schunk (2002) suggests that students model adults when their peer’s competence is questioned. Peers are more effective models when students hold doubts about their competence. In a learning situation, a student watching a fellow student successfully perform a task may raise a learner’s self-efficacy more so than observing an adult. A student, such as S1, may not have seen herself as ever being able to achieve a level of mastery particularly when it is demonstrated by a teacher.

The following examines the socio-cultural approaches to learning which have an effect on the participation of females in Technology Education.

### 5.3.7  **Socio-cultural approaches to learning**

The results for socio-cultural approaches to learning were shaped around the following topics: heterogeneous groupings, teaching and learning, shared practice, standards of judgement, quality and creativity and consideration for difference.

### 5.3.7.1  **Results**

### 5.3.7.2  **Heterogeneous groupings**

Socio-cultural learning gives consideration to the diversity of learners in a culture sharing environment. Learning is distributed, interactive and contextual and the result of a learner’s participation in a community of practice. The students were not a diverse group. They were white Anglo-Saxon, middle class students. Many of the male students, as discussed earlier, participated in more than one Technology related subject and while there were race and cultural differences these factors did not affect what the students did in the workshops. Students worked individually in the Technology Education workshop though they stood in groups at workstations which catered for up to four people. The female student was always located at the front of the class. S1 had made a clear choice to be part of the class as the ‘only female’ and yet the question arises as to what connected her to the class in terms of engagement and higher levels of inquiry learning.

### 5.3.7.3  **Teaching and learning**

The teacher modelled work at the start of each stage of a project and then explained the processes and choices within the project. During the design and planning stage of the letter box
T1 showed a prototype and drawings and demonstrated how ‘the net’ was to be developed as it was drawn. T1’s pedagogical style was to then leave the group and enable individuals to develop the task according to the directions he had given. Each stage aligned with a staged assignment task the students had been given. There were workbooks which contained the written information students would need and spaces for them to record their plans and assignments. The learning was contextualised to the progress points that coincided with the workbooks as developed by the department in the school. T1 did not feel he needed to capitalise on the real life context of the task so that it fitted with the reality of S1. In the case of the letter box, S1 articulated, that it was of no use to her.

5.3.7.4 Standards of judgement

There were factors of time pressure evident during the lessons. Students did not spend extra time outside of lesson time working to complete their artefacts in the workshop. The teacher supported the female student and ensured she was up to date with specific parts of the projects each time a classroom visit was arranged. There may have been a research effect on the development of her work because of the research study and knowing that the researcher was again arriving to look at her progress. The two artefacts she had worked on from design to realisation had altered in between the planning and the next observation visit.

He knows that I do the very best I can (S1 at the end of the project phase).

S1 believed that the teacher understood that she tried her best to work, even though she was new to woodwork and that as long as she works efficiently and tries to do as much as she can independently he (T1) will be content. The second time factor was to meet the work program requirements for assessing and reporting. It was this factor which was used to enforce the learning at times.

5.3.7.5 Shared practice

Team and community of practice sharing is the fourth factor in socio-cultural approaches to learning. There was one pivotal day when the teacher was demonstrating the letter box and folding metal for the flap and possible designs and construction methods. The female student was in the class at the start of the lesson but the taped dialogue indicated she was not in the room for what was a key learning sequence in the teaching unit. The student and her peer supporter had gone outside into the common area. Two questions arise; had other issues taken over from her needing to learn from what was demonstrated that day or was it a choice factor that she could do what she wanted in the class and would then rely on the teacher supporting her learning when it suited her? This same lesson when S1 was asked her to complete the reparatory
grid for the LED light. S1 had questioned what it meant and that she did not know how to complete it.

5.3.7.6 Quality and creativity results

Quality and creativity were factors in this learning environment. I showed my surprise at how S1’s letter box plan had changed. T1 responded;

*She [S1] needed to learn the basic requirements of the joins before going onto anything fancy* (T1).

An early discussion with S1 during the design lesson in the graphics room showed her thinking was about the letter box being a turtle letter box. The design drawing illustrated her planning a green acrylic overlay. To demonstrate she gestured the shape with her hands.

*Maybe melt the acrylic – make a box to go under* (S1).

The male student standing with her was rolling his eyes in disapproval but S1 was definite about what she wished to do despite his disparaging remarks and apparent lack of peer support.

Her LED light was modified and then the shape that was to be the front of the letter box altered from the planning phase to the final making day. Photographic evidence of the plan and then the final product show that the design feature was not realised. S1 had initially drawn a box and had wanted to add an animal head to the front plate and colour. The plan was to have a frog shape on the front. This was missing. At one stage she was going to put Perspex into the making of her letter box. S1’s design became a straight forward rectangular plywood box. When I asked on the last visit how could this be, the teacher replied;

*She had to go back to basics and learn the joins* before going onto ‘anything fancy’ (T1).

5.3.7.7 Considerations for difference

S1’s designs had gone back to basic construction styles without any apparent consideration for her initial planning designs. The differentiation was about the learner and her abilities within the community of practice. The audio transcript shows a discussion on being able to view the letters within and about their security. Her male peer supporter who was not supportive of her design choice but did make a clear perspex mail box in bird house style and was fixing joiners and struggling with adherents on the last visit to the workshop.

The following provides the analysis for the sections of heterogeneous groupings, teaching and learning, shared practice, standards of judgement, quality and creativity and consideration for difference as discussed in the results above.
5.3.7.8 **Analysis**

The following section presents the data analyses through the themes of heterogeneous groupings, teaching and learning, standards of judgement, shared practice, quality and creativity results and consideration of difference.

5.3.7.9 **Heterogeneous groupings**

In examining factors which encourage and facilitate female learners in Technology Education this analysis shows that the social environment can be a major influence on females and their wish to remain in a Technology class. Schwab (2013, 1973), in establishing the four common places for learning, says it must be a process whereby we involve learners in engagement for learning. The four pillars which shape a learning environment are the students, teachers, the milieu and subject matter. He argues that it is higher levels of inquiry which will change how students engage in the created ecology (Schwab, 2013). S1 had made a clear decision to be part of the workshop environment and finding how she was to ‘fit in’ shaped her early learning behaviour. Her acceptance into the class by the school, family and the departmental teachers also indicated that there was a social acceptance of a female being able to participate in this type of learning. The ability to engage makes no judgement on the outcome of the engagement.

5.3.7.10 **Teaching and learning**

In terms of role modelling for the youth in the class and particularly the female student S1 made little change to his normal teaching pedagogy. Fleer and Jane (2011) discuss education in Technology which orientates learners to real-world community life. Peer support in this context is the extension of play and fantasy from a child’s point of view transposed into the workshop secondary setting. Planning for technological learning experiences while keeping in mind the needs of youth in a social context can more deliberately position young people within the community. It would appear to be the social context of the learning and its place in the world outside of the classroom that is important to the female learner. Her willingness to interact with the artefact development was lowered because of her lack of connection to the artefact and its use.

5.3.7.11 **Shared practice**

It appeared that when S1 choose to leave a learning demonstration she chose firstly, not to be part of the shared learning and secondly did not see the relevance of the activity to her artefact development. Blewitt (2006) argues that the “building of sustainable communities, partnerships and cross-team working are key elements in community development” (p. 152). He notes there are skills to be learned which include learning how to lead and facilitate, how to be patient, how to listen, how to communicate empathetically and clearly, and how to get on with others.
Blewitt claims that while some of these skills can be learned through formal education many are best learnt in and through practice, and stated that, “We need to not only cue people into learning but also teach people how to learn together and form a community that shares, listens and learns through normal and commonplace activities” (Blewitt, 2006, p. 155). In terms of encouraging the participation of females into Technology classes there is an amount of teaching that is not about artefacts but about processes, sharing and functionality in workshops that is important. The links to real life transference of processes allow females to view how the products then fit into their view of the made-world.

5.3.7.12 Standards of judgement

Time pressure appeared to become a driving factor in the learning context of the study. It could be interpreted that if S1 was to finish the artefacts to an adequate standard she would need to be given assistance from T1. The second consideration was the pressure of competitive assessment. Each individual would be scored for their assessment which is sent off to a standards panel (QSA). Panels comprised of experienced teachers in the field make judgements on standards of the marking of student’s work which then reflect on a school and its teachers. The issue arises as to the judgement made for the female student and others who have gone before her. If as was indicated that the female students do very well. One would question what standards are the female student’s judged against given their early lack of experience.

5.3.7.13 Quality and creativity

The quality and creativity of the project are important as an outcome that would be judged. The socio-cultural nature of the learning environment of the school was competitive. The notion of competitiveness did apply more to the boys in the class. S1 knew she would receive support for her work and did not use the boys work as a comparison to hers. S1 also knew she was important as an entity. She was the female in a non-traditional learning area. Her presence appeared to be shaping the social and learning environment for both the class and the teacher. The researcher did not have the impression that S1 would be judged/ rated the same way as the boys given the simplicity of the artefact she appeared to have been given. Murphy (2007) would suggest that there needs to be consideration to the female input of a project. This was contrary to T1’s opinion as expressed in the results section.

5.3.7.14 Considerations for difference

Educators can make allowances for difference. One needs to question at what point the difference is a different course of action. Benjamin (2002) argues that the differentiation in instruction may allow for learner differences in learning styles, interests, knowledge, socialisation needs and comfort zones (2002). In this case study, there was a differentiation of
approach which did change the socio-cultural context of the classroom. This was heightened through the extra support provided to S1 and the results she arrived at within the learning community. There was an apparent indifference to the presence of the female student and her achievements from most male students excepting her peer supporter.

The following examines the values theme of the case study in relation to the female student.

5.3.8 Values within Technology Education

The results for values within Technology Education were viewed via understanding the concept and decision making choices in sustainability.

5.3.8.1 Results

5.3.8.2 Understanding the concept

Few of the students interviewed in this site could articulate what they understood as a concept of values. Students did not know and were unable to respond to the notion of values. When the researcher explained that values could be ‘what motivates you to engage in an activity or that they could be about sustainability or choices of materials’, there was some nodding that the students did recognise the terms.

The researcher asked S1 about values and what values she believed were taught in Technology Education. The reply was:

Teaching skills, and having patience (S1).

The concept of terminal or instrumental values was foreign to this group of students. This should be a factor that is considered as a means for why a student wished to take a Technology class and how they then operate within the class. The male students could give reasons for doing the course in Technology Education. The reasons included, wanting to do all the practical subjects they could. The teacher highlighted some students with longer term plans for using technology. These were their terminal values and could be articulated to appeal to a broader cross section of learners in the school population.

When I spoke to the teacher about the interviews with the student (S1), and her male peer supporter, about values his reply was:

It is not something we talk about here (T1).

5.3.8.3 Decision making choices in sustainability

The Technology curriculum covers resistant materials and sustainability. The presumption should be that there would be some discussion with students about why one type of material may be chosen over another when planning projects. Several boys did have their own wood
supplied for their letter box and could explain that it was going to add value to their family homes.

Few students could articulate a preference for one timber over another or a quality or criteria as to why one may be a better choice. The planning classes did allow for choice and the teacher did point out options while the researcher was there. Most students did not believe they had a wide choice but they did have reasons for their choice of materials. When the male students were asked about making choices of a particular wood in their projects a number of boys said:

Oh I chose this wood because of its texture, colour, it will look good, it will weather well.

None of the students had the notion of choice for sustainability or environmental impact as to why one material may be better than another.

Some said, This is what we were given (male students).

5.3.8.4 Analysis

The analysis for values within Technology Education was viewed via understanding the concept and decision making choices in sustainability.

5.3.8.5 Understanding the concept

In discussing the relevance of the artefact with S1, she stated that personal values were important to her. She did not value the artefact, the letter box. In a conversation when she was asked about the worth of the item to her the reply was;

What do I need a letter box for? (S1).

The question from the researcher was intended to focus on the values that surround Technology; specifically the skills and the process and the value they held for her as a student. S1 explained she was a border from Hong Kong, an apartment dwelling population. It was a clear point that the artefact had no relevance to her.

The relevance of the artefact to the female student did make a difference. She had no intrinsic, or instrumental value for the project itself. This factor relates to her motivation on the project as much as how much she would value the task and the finished artefact. In interviewing T1 about female relevant teaching practices he reiterated the notion that the jobs they do are gender neutral.

5.3.8.6 Decision making

Technology as a learning area has the potential to develop sustainable and ethical concepts in students in relation to resistant and finite resources as well as opinions as they related to the
individual. Pavlova (2007) strongly argues for the teaching of ecological sustainability as part of a values notion that students live with. S1 did not hold a long term career aspiration for participating in Technology Education however she could be made aware of the contextual impacts of her own technological decisions. Her short term goal was to achieve well in the class and engage in the projects that were on offer. In doing this she acknowledged she was learning some skills for life.

Values components include motivational, cognitive, affective and behavioural elements as argued by Rokeach (1973). Instrumental values are motivating because their idealised modes of behaviour are perceived to be instrumental to the attainment of desired goals. Terminal values represent goals beyond the immediate. They are conceptual tools used to enhance self-esteem. This factor would be applicable as a concept which would encourage female learners as well as male learners into the Technology classes and into learning beyond the school gate.

The engaging factor for female learners is to learn physical and participatory skills that will enable them to apply the skills in other areas of learning and as life skills. The motivation of such achievements may in turn endorse further action through success. Murphy (2007) argues that the life skills are equally as tangible.

The following section summarises S1 in the context of the Technology Education class.

5.3.9 Summary S1

Despite the initial hesitancy of the female student (S1) to engage in Technology Education, she could verbalise that she had chosen to take this class in order to ‘do something different’. There was a motivation to participate though she was not clear in articulating her end goal. By the last class visit almost four months after the first she was more definite about her future educational pathway than she was at the start of the year. She had matured in this environment as well as taken on a future view of what her goals would be. A Bachelor of Arts was her goal but she was quick to add that what she was learning here were life skills. S1 noted that she had benefited from the learning so far in this class.

S1 did believe that Technology as part of the STEM subjects may be useful sometime in the future. Having learned new skills, to sketch, design and make a model has provided her with opportunities to learn different skills that perhaps can be used over time.

The following provides the researcher’s summary of factors emerging for the female student.

5.3.9.1 Factors emerging from the analysis:

S1 learnt best by working with others. Through social networking S1 was able to discuss ideas in a non-competitive environment, reflect on these views and then go ahead and work on her artefact. She did rely on her immediate peer and T1 however as the unit progressed she became
more self-confident and engaged other male students who were working close to her. What she reported in her interviews and during the working time in the class was consistent with the literature. Female learners prefer clustering together rather than the independent notion of boys competing for completion.

The analytical skills of the female student appeared to be high. When she was alone and responded to the researcher, she expressed some clear and precise views as to what she was doing within the Technology class.

The female student did appear to rely on support. In this case it was because of the assured support of T1 and H1 and their assurance before the student entered the class. She felt that she had been provided with some security by her teachers who would guide her in this, an unfamiliar learning environment.

S1 placed an importance on peer support from her friend in the class. She enjoyed the co-operation of others along with their acceptance and recognition of her presence in the Technology class. She did not use her voice in the class accept where it related to having students find tools for her or locate items she needed. The female student saw the benefits of the Technology class as an outcome of the activity she was engaged in, namely learning skills for life.

5.4 Case Study 1 - Head of Department (HOD) (H1)

The third dimension in this case study included an interview, discussion and observations with the HOD (Technology), referred to as H1.

The initial meeting with H1 provided an insight into how the Technology department ran within the school. The meeting provided the researcher with information as to how the school functioned and how the Technology staff interpreted the work programs that were written to guide learning in the courses. This interview provided the researcher with an understanding of how the various Technology courses were implemented and organised in the school setting.

5.4.1 Learning Ecology

The following section presents the data results, analyses the written interview schedule, observations and conversations with H1.

5.4.1.1 Results

The initial meeting and interview with H1 was early in the school year. H1 had received approval from the Head of Curriculum that the researcher could visit the Technology Department and possibly work with the females in that subject area. H1 was chair of the QSA
Chapter 5. Case Study 1

The year 11 Technology Studies class did three projects staggered through Semester 1 and 2. Materials were supplied with options but there was scope for extension and for the students to source other materials. Skills that students could engage in included metal forming, gluing, basic hand work, soldering and timber working skills. The artefacts focussed on the appeal of the items to the families of the students doing the subject.

*The ‘take-home-ability’ of the project is what is important. Each artefact has function and physical use with the aim of providing a motivational factor for all students. The first Technology Studies project is a lamp task which appeals to the year 11 girls. It includes some electronics, some soldering, a design and ideation folio. Students finish the work in the first term. (H1)*

H1 believed that some important aspects of Technology Education are not really assessed in the syllabus. These aspects included attitudes, perseverance, the Idea of taking on their own responsibility as people.

*Project management skills should be what is aimed for over the two years of the course (H1).*

*We do not let the context of syllabus drive projects (H1).*

*Projects themselves are important and activities can be made to fit into syllabus requirements. This is the same for Engineering Technology – fit into context rather than work program. The context of the program should not weigh down an activity (H1).*

H1 went onto say that experience had taught him these things.

The interview reviewed resource needs and requirements for the classes and the management of the subject area. Particular needs of the class were managed by the teacher not the HOD as his role was one of middle manager.

The following analyses the results of the learning ecology in relation to H1.

The learning environment in terms of a physical facility was designed and established by the H1 who led and co-ordinated the department was reflective of the school. It was H1 who interpreted the school ethos into the department and conversely represented the department to the school and the community. H1 reported during the interview that he had spent time reflecting on how the department could encourage more females into the Technology department. He reflected that there had been more females in previous years and it was an issue he has grappled with but not solved.

In this case study, decisions related to learning and student activities appeared to be made in conjunction with the other staff members each of whom had expertise in particular
areas. For example the background of T1 was in carpentry and there a logic in his taking the woodworking and mixed skills classes. Consideration by the teachers was given to the appeal of the artefacts to students and families and how much they reflected what the teachers aimed to achieve. As H1 stated the take-home-ability of the project related to its client appeal.

5.4.1.2 Analysis

Petrina (2007) argues that it is the mission of Technology teachers to demystify Technology and its applications as well as re-sensitize students to the implications of their technological decisions and surroundings.

*Their mission is to provide experiences for young people to develop and question feelings, knowledge, and skills that empower them to participate in all facets of technological endeavour…*(Petrina, 2007, p. 190)

In terms of assessment, the staff saw key factors in Technology Education as not being physically assessed. Some of these notions may apply to females and the innate manner in which they learn. The key discussion was that H1 saw the interpretation of the syllabus as pivotal to what they did in the school. In this sense, there could be more scope to make this work fit for female learners and yet what really occurred was the tasks drove the learning.

H1 was known to be very experienced and appeared to lead the team of teachers using his experience to guide and oversee what was occurring in the Technology department. His consideration was to best use the well-equipped facilities of the Technology building and cater to his clientele who were the parents as much as the students in the school. The nature of the school meant that middle management were accountable for costs and outputs from their departments.

The following examines factors affecting student choice from H1’s perspective.

5.4.2 Gender and Technology Education

In interviewing H1, the focus of the interview questions was to examine what factors, in context, would and do influence student choices in selecting Technology subjects. The corollary of the question is then - is there a difference for female students when compared with male students?

5.4.2.1 Results

The results were viewed through three topics: gender and the courses, promotion of the subject, and relevance of learning.

5.4.2.2 Gender and the courses
One discussion with H1 during the interview was about the content of courses and what may or may not be covered in the senior school courses in Technology. The discussion moved to where the subjects would equip female students to study after leaving secondary school.

*Graphics: leads to architecture and interior design. There are two groups of girls, Engineering and Physics. Scholarships are readily available for females going into tertiary in those areas but less so for Technology Studies. Technology Studies is viewed as less academic, more practical and can go all directions. Some females who have gone into primary teaching have taken the course. (H1)*

### 5.4.2.3 Promotion of the subject

H1 noted that to promote the subject of Technology more within the school population perhaps there was a need to go back to look at, the primary area of the school. They could look at the delivery of Years 9 and 10 Science. The senior school at this site was regarded as Years 10 to 12. Subject banding is year 8, 9 to 10 and then 11 to 12. Years 9 and 10 Graphics and Design and Technology classes were growing as was the junior Technology department and the school had employed another Technology teacher for this reason. Given that all students participate in Technology classes in the junior school, they were seeing greater numbers of students.

H1 suggested it could be the orientation of boy's brains. In order to learn boys will test something out and do it over again. That suits them (the boys) better in this area. Finally, he believed that females wanted to look at the social issues rather than just practical aspects of a course.

*The Year 11 course develops skills, while Year 12 builds on those basic skills – moving to open design briefs. Quite a few females do the 9 or 10 subjects of Design and Technology or Graphics, but the numbers drop away in Year 11. (H1)*

H1 viewed the projects undertaken in the Technology department as gender neutral and relatively low tech. Megatronics – the automator is the final project in Year 11 and in his words is

*Still suited to girls (H1).*

During the interview, the issue arose in relation to the small numbers of females in the Year 11 course and the numbers of females;

*Once they [the female students] start, they stay. In the past we have had groups of art students 7/20 in one class. Fashion studies with sketching of garments are very separate ‘girls’ from Design and Technology ‘girls’.*

*‘Girls’ who are in the Technology Studies classes are A students. The females can achieve with creative design (syllabus) that allows for skill and creativity. Drawing does suit females. They may need help with drill press as perhaps they have had little or no prior experience at first. Teacher support overcomes issues such as these (H1).*

### 5.4.2.4 Relevance to learning
The issue of relevance to the learner was highlighted in the section related to the female student and the letter box. Her statement, *Why do I need a letter box?* (S1) highlighted that she did not identify with the activity nor its outcome.

S1 was poignant in terms of her motivation to participate and realise the product. A similar statement was made by a Year 10 female student who when asked about a 2D cut out of a car said:

*Yeh! This is really a ‘girl project’, isn’t it?* (Year 10 student).

### 5.4.2.5 Analysis

The data analysis was viewed through three topics: gender and the courses, promotion of the subject, and relevance of learning.

### 5.4.2.6 Gender and the courses

The issue of gender functionality and neutrality and developmental skills was an issue that the HOD and his staff had discussed and believed they were addressing as best they could. This topic was reinforced during the interview with T1 about the boxes and letter boxes of the Year 11 class as discussed in the analysis section under T1 and S1.

The Technology department of the school did acknowledge the need for more females but failed to understand how they could promote the notion. Essentially they reinforced a traditional social view of where women want/should be. Wajcman (1991) argues that women are low paid because they are unskilled; because women’s work tends to fall into the unskilled or semi-skilled categories of jobs. She uses the example of nursing which requires a great deal of training, ability and technical knowledge and yet is not regarded as a technical job because it is women’s work. She speaks of the work of women as deemed inferior simply because it is women who do it. The search for objective knowledge as expressed by Belenky et al. (1986) encourages both men and women to promote their understanding of the unknown.

### 5.4.2.7 Promotion of the subject

There is an apparent mismatch between what the perception of the females in the Technology program think and what the male teachers who are writing and delivering the programs for the female learners think is relevant to the female students. The experience of the male teachers and H1 is acknowledged and yet their approach to modern learners does not coincide with current trends in what youth want. Youth needs, alter from community to community and can only be analysed with the cohort and the potential cohort of clients who will become the learners.

In analysing the factors which affect students’ choices, H1 provided some insights into the functioning of the Technology department for the staff and the students. His management role meant that he was not always face to face with students in the workshops and he deferred to
the subject teachers for specific questions about why some may chose the course over other students.

The HOD role was a managerial one and his liaison was between the management team of the school and the staff in the department. He had reflected on the issue of student choice in the school but did not see how the numbers of female participants could be improved in the short term. Wajcman (1991) in highlighting Technology as masculine culture says that the traditional conception of Technology is heavily weighted against women. By its very definition, she says, Technology has a male bias which ignores the technologies that affect every aspect of our everyday lives.

*The enduring force of the identification between Technology and manliness, therefore, is not inherent in biological sex difference. It is rather the result of the historical and cultural construction of gender* (1991, p. 137).

Wajcman (1991) supports the concept that real differences do exist between the symbolic representation of Technology and its sharply gendered difference. Real differences exist between women and men in relation to technology. To understand the nexus, Wajcman provides some feminist analysis around women’s relationship to masculine cultural worlds. “Bomb culture and war efforts feature men in images as much as the language that is used in these contexts. The obsession with control parallels a male dominated Science community with stereotypical images of men, machines and computers” (Wajcman, 1991, p. 141). The study of the social construction of masculinity is noted as a theme in the sociology of gender. It is a dominant cultural idea that does not necessarily align with the majority of men but is what society believes. *He who commands the latest Technology is seen as involved in directing the future and is highly valued* (143).

The final point argued by Wajcman around masculine cultures of Technology relates to engineering.

*Of all the major professions, engineering contains the smallest proportion of females and projects a heavily masculine image hostile to women* (1991, p. 145).

This is of particular note in Western countries. It is unique in that engineering cuts across the boundaries between physical and intellectual work and yet maintains strong elements of mind/body dualism and the dualism is extended to the social construction of an engineer is the polarity between science and sensuality, the hard and the soft, things and people. Given that the Technology department in this case study was catering to a greater number of students (both male and female) in the junior school, then the argument of H1 did not follow that what they were doing was okay. Proportionally, they were not in-taking a cross section of the population at the senior post compulsory phase of education. The Year 11 females were still missing.

5.4.2.8 Relevance to learning
The belief of H1 in relation to his school and the students served to further the socio-cultural factors which Wajcman noted two decades ago. The discussion which follows in the later theme reflects the socially accepted view in the school that females prefer some subjects to others. *Technology Studies is not viewed as a ‘girls’ subject* (H1).

The greater number of students in the compulsory junior years was not translating to more female participants in the senior school.

H1 suggested that the gendered brain orientation may favour one sex opting to take the subject over another. Knopke (2012, 2013) has argued that gender does not make a physical difference rather the socio-cultural and gender bias of the context in which females grow, learn and engage does make a difference.

The following looks to aspects of language and its use with regard to female Technology students from the perspective of H1.

### 5.4.3 Language use in classrooms

#### 5.4.3.1 Results

Apart from the belief in gender neutrality of projects, there were no specific discussions with H1 around the use of language and terminology in the classroom with H1. The discussion in this area related to the work of Spender (1985) and her writings in the social power of language as it related to this study.

#### 5.4.3.2 Analysis

This was not a discussion point that H1 wished to have. He was focussed on the practical aspects of his department. From discussions with the teacher and H1 and understanding their belief in what they were achieving was gender neutrality, it would appear to follow that there is a lack of acknowledgement that they needed to have a different approach to learning for female students. A different approach would commence with the type of talk that would be used with females as opposed to the male students. Just as a teacher would conduct a different conversation and use of language to a truck driver, Spender’s (1985) research shows that, due to the expectations of different work roles for females as against males’ work roles, conversations will be different.

*Language is a powerful human tool and we must begin to ask what role it plays in maintaining and perpetuating existing social structures, what contribution it makes to our hierarchically ordered classist, racist and sexist world view. When we begin to address….questions of this kind, it will be possible to shift towards locating inadequacies and differences within the social structure and not individual human beings.* (Spender, 1985, p. 51)
The following discussion relates to motivation.

5.4.4 Motivation

5.4.4.1 Results

This topic was not discussed directly with H1. In relation to student work and projects H1 made the following comments.

*In planning course work with staff for this school the ‘take-home-ability-of a project’ is a motivational factor for students and families. (H1)*

H1 believed that the projects and the increasingly independent decisions that students had to make was a motivational factor in their participation.

*‘Girls’ who are in the Technology studies classes are A students. ‘The girls’ can achieve with a creative design (syllabus) that allows for skill and creativity. (H1).*

H1 was of the belief that as students engaged they became more motivated through their achievements. This view could be related to his earlier statement that the females who did participate emerged from the course as high achieving students. There was no discussion as to whether the quality of the program, the quality of the teaching or the skills the learners achieved and outcomes that the students arrived at would give them greater motivation over the initial terminal careers choice as a motivational factor.

Given the relatively short length of the period of the study and the observation, it is difficult to draw a firm analytical conclusion with regards to motivation in the specific class. The students, including the female student, did appear to become more independent learners over the time of the research observations. They made materials and tools choices without recourse to the staff.

5.4.4.2 Analysis

Motivation for the subject stemmed from the H1’s belief that the affirmations that came from artefacts which were taken home to families would provide incentives for students to achieve. This appeared to take precedence over the notion of student progression through course itself. H1 would argue that due to the projects the students automatically became more independent and self-managing. This in turn made them more self-directed and motivated. Pintrich and Schunk (2002) argue that it is the engagement that stemmed from peer interaction and maturation along with an end goal that provided the motivational factors.

Pintrich and Schunk (2002) argue that instructional practices have an important influence on student performance and an impact on motivation. Instructional procedures should promote student motivation and achievement (2002). Reviews of previous work help students
prepare for new learning as well as creating a sense of self-efficacy for learning. If students feel they understand the prerequisite material, they will be able to learn the new material. “Series of small steps allows for success and sustains student motivation to learn” (p. 317).

Murphy (2007) argues that if we put aside discussions of gender that reduce the discussion to the biological realms of sex and the fixed attributes of individuals then we can move forward to meanings and experiences as they develop in technology. H1 appeared to support this view that once the students began to learn in the subject area then they achieved and in turn were motivated. Knopke (2013) argued that maturation over time in the workshop environment meant that most students were able to discuss their work and in turn were confident to achieve. However it is impossible to conclude given the short length of the study that S1 developed any further motivation for learning in this area.

The following examines role modelling and peer support from H1’s interview.

5.4.5 Role modelling and peer support

5.4.5.1 Results

The topic of peer support related to the self-management of projects as students progressed in the Technology subject area. H1 stated that the boys would prefer straight out construction however given that the workshops only contained low level safety items it is easy to have smaller projects and slightly larger numbers. H1 did recognise the need for support for S1 and did discuss her needs in terms of those of the class. Like T1 he appeared to believe that it would be the staff support which would keep her in the class and developing skills that were necessary for the course. No discussion was entered into as to what the female students would prefer.

This topic of role modelling was not discussed with H1. H1 deferred to the role of the teacher in the class as the key to the success of the female learner.

5.4.5.2 Analysis

H1, in retrospect, recognised the need for support of the female student and discussed this in terms of her needs for the class however he did not believe that a structured program would provide any more support than she was already being given. Petrina (2007) would argue, as would Rasinen, Ikonen, and Rissanen (2006), that educators regardless of the country, must teach the human beings within technology. The same should apply to role modelling for the female student.

Murphy (2006) argued that while women’s involvement in Technology grows there remains problematic aspects to their engagement. As Murphy indicates, “Bringing women ‘into
the fold’, may alter this aspect and it is through first steps such as peer support in a secure learning environment that this could be achieved” (p. 66).

The following examines the socio-cultural approaches to learning in Case Study 1.

5.4.6 Socio-cultural approach to learning

5.4.6.1 Results

The results for socio-cultural approach to learning is discussed through the following topics; the context of the school, and challenges for female students.

5.4.6.2 Context of the school

The discussion related to the socio-cultural milieu of the course in the context of the school. The interview with H1 focused on the purpose of this study to encourage more females into tertiary areas such as Engineering as a result of their participation in post compulsory schooling.

> *Engineering from a teaching in schools view is seen as less of the practical skills, and more experimental. Half the subject at university level is statistics. Theory based around materials and forces makes it high end and linked to Physics. Perhaps I (researcher) need to look at the school numbers doing Physics (H1).*

5.4.6.3 Challenges for female students

H1 spoke of females who earlier in the academic year did the Science Engineering Challenge at University of Queensland. He stated, however, that females participating in that activity do not translate into subject choices with the females in this school setting. H1 said he has tried to promote Technology with Year 9 and 10 girls but is not sure why the numbers drop away. He did not believe he was empowered to alter the trend.

> *The year 9 to 10 Food Studies and Fashion Studies translate into Senior Hospitality with equal numbers boys and girls but the equivalent does not occur in Technology (H1).*

5.4.6.4 Analysis

The analysis for socio-cultural approach to learning is discussed through the following topics; the context of the school, and challenges for female students.

5.4.6.5 Context of the school

The community of practice in which the school sat had multiple layers. Siemens (2006) argues that the learning community will drive practice however, H1 saw the community surrounding the school as driving the social practices. It was these social beliefs and values which kept female students from enrolling in Technology Education in large numbers. It was the social norm of the community which recognised that females would progress into the tertiary sector
but not into the hard-hat Technology fields. Hence school reflected the outside demand of where students would transfer to for tertiary education. Ford (2011), in her study, illustrated that female perceptions of what was the social norm began through their socialisation processes at home. The school view reinforced her findings.

5.4.6.6 Challenges for female students

Culturally, H1 saw his department as bounded by the school and its expectations. He discussed the changing nature of youth and saw this as having an impact on female engagement in Technology. H1 did not believe there were any other adjustments he could instigate in the Technology department that would realign the situation in the short term. Pintrich and Schunk (2002) write of the notion of school adjustment. They note that students as well as schools undergo changes from year to year. Success in negotiating changes in teachers, classes, rules and procedures, performance expectations, difficulty of the work and peers shape attitudes towards school and outcomes.

The extent of social support and relationships as well as connected involvement and peer relations are powerful factors in motivation for learning. The quality of the friendships and relationships within the learning environment can alter patterns of behaviour within the classes. (2002, pp. 387-388)

If there were strong peer ties and social support as well as a value placed on females in engineering and scientific Technology as viewed from outside the Technology Department, then perhaps the number of female students in the senior classes would increase.

5.4.7 Values within Technology Education

Values as a concept was not discussed with H1. The similar discussion with T1 appeared to reflect a general view that it is not a term used in the Technology department.

5.4.8 Summary

H1 was able to provide the overall view of the Technology Department which he managed closely. The daily running, interactions and decision making rested with the teachers. H1 knew the numbers of females were increasing in the junior classes due to the participation of all students in the junior school area. This brought about the hiring of more Technology teaching staff.

H1’s lack of foresight as to why the senior school female student numbers were dropping, or at least not increasing in proportion to the population, appears to be linked to the nature of programming caused by conflicting timetabling. H1 believed he could flex the student design briefs to fit the context and yet this did not appear to be happening at the student level from the female student’s perceptions.
The design briefs must be more flexible to cater to the clientele (H1).

The letterbox project had no relevance or contextualisation for the female student (S1) to value it as a worthwhile artefact at its realisation.

The following outlines the researchers observations for each of the themes discussed in this case study.

5.5 Case Study 1 summary

The researcher notes were made under each of the themes in alignment with the teacher, student and HOD data collection for the study. The researcher visited the site over the course of the pilot study and the full unit of work. This spanned two school terms.

5.5.1 Learning Ecology

Pedagogical ecology concerns the relationships of instructors and learners in learning environments. It is the symbiotic interactions seen by the researcher which provide insights about the course, the learner and their behaviour and development (Nystrand, Gamoran, & Carbonaro, 1998). The interrelationships are highlighted by Schwab (2013) in discussing the four common places of learning and the context in which they take place and shape the environment. There was a disciplined working environment in the workshop. Individual students focussed on their own projects. They interacted with the class during demonstrations and key planning times but returned to their individual projects once the shared instruction time ended.

Nystrand et al. (1998) expand on the roles of participants in learning environments. They claim that roles are epistemological, and it is the discourse between participants that defines the operationalization of the group. There was limited discourse between participants. Students worked individually while located at benches of up to four students. At times the students would stop and have a discussion with a peer or the teacher but there was no holistic interaction. Time pressure appeared to be the limiting factor for students and experimentation. There were many reminders that they had limited time in class and projects had to be completed by the due dates.

The workshop space was well equipped for the number of students. Some students used the long counters at the back of the room. At times others sat in the common space outside the room. The remainder worked at the square benches in the middle of the workshop.

The female student (S1) located herself at the front of the workshop at one of the square benches. S1 changed places but was always at one of the front benches. Tools for all of the jobs were close at hand and the student was able to quickly locate what tools she needed once she knew what was required. S1 saw the working environment as nice and bright and a good
working space where she could interact with a group. Her early impression was that she would recommend the subject to others and she saw it as expanding her ‘way of thinking’.

Over the course of the visits S1 not only gained confidence in her own self but also trust in what she was able to achieve and who she could call on to give advice. Usually, this was the teacher, after the male peer supporter and S1 had discussed an issue. For S1, this was a fully supported environment and she was better able to discuss more of her work later in the second term.

The final interview with the female student saw her continue to stress that she was new to the subject area and had taken the subject in order to try something new. She continued to rely on the teacher for support in the class setting and with the construction of her artefact. The surety of T1’s support provided her with some confidence.

There was a marked change from a planning drawing of a turtle letter box (photographed as a drawing) to a rectangular box on the next visit. When asked about the changed work, the teacher commented for the student that she needed to go back to basics and learn about construction techniques. S1 happily worked on this letterbox design and was applied in what she did. She tested ideas before completing the task on her letterbox.

S1 had adapted and appeared to make positive progress in what was a new learning environment at the start of the year. She was able to comfortably interact with others and the teacher by the end of research period.

During the technique and workshop demonstrations, S1 had to be encouraged to attend the benches and when asked a specific question a male responded for her as evidence in the audio transcript. Her voice remained between herself and her companion.

The second key period when she was absent from the room (audio recording) was a key learning episode when the choices and possibilities and skills for the letterbox were being demonstrated. This lesson was the next visit after a design lesson for the artefact. In that lesson S1 was relaxed, chatting in general to the males around her. She had a sound design to work with and seemed to gain some confidence from this clear direction. It was not clear who had provided her with the plan. The following workshop lesson she chose to absent herself from the workshop and sit in the communal area of the building with her peer supporter.

S1’s participation altered over the course of the two terms. Familiarity with the patterns of organisation and the learning environment and ecology meant that she was less self-conscious and more functional during the learning episodes.

5.5.2 Gender and Technology Education

Benjamin (2002) wrote of the differentiation of instruction for Technology classrooms. He intended that teachers employ a variety of classroom practices that accommodate differences in student’s learning styles, interests, prior knowledge, socialisation needs and comfort zones. The
notion links to the Bernstein code of modality of pedagogic transmission and acquisition which affects learners. “Codes can be transmitted in many forms and affect gender, race, religion each according to the voice message which can be transmitted in various ways to position subjects to both discursive and physical resources” (Bernstein, 2003, pp. 11-12).

On first meeting with S1, S1 was hesitant to converse or discuss her project and the artefact she was making. On return visits to the classroom, she discussed the progress she had made. S1 in the early lessons discussed her Technology project with the two boys who were working at the bench where she was. She saw herself as less secure in terms of knowing what she was doing and spoke of having less knowledge base than the boys.

One of the key demonstration lessons was a half a double lesson on techniques that could be used for the letter box project. The audio tape transcription shows that S1 and her peer supporter were not in the room.

In working on the LED lamp (the first project during the classroom visits), S1 trialled putting blue plastic inside the metal surround of the lamp. She noted that no one else had this shape or idea but felt that she did not know enough about switches, LED covers, attaching items to be able to realise what she was aiming to do. The finished product showed sound coverage of the required work and her ability to design and complete a task. See Figure 5.2 below.

![Completed LED lamp](image)

Figure 5.2. Completed LED lamp

S1 was able to complete her first design task with support. She was proud of this achievement and sent the researcher a photograph of the finished product. See the illuminated lamp above, as shown in Figure 5.2.

When I was asked by two boys why I was in the room, I explained my research and they agreed that more girls should do the subject. The boys were very clear to point out that they stated;

*They [the female students] preferred fashion* (male students, Year 11).
The boys could tell me where Technology Studies could lead them in the future and that they had done the subject since year 8. It was for them, fun and a hands-on subject but an afterthought was;

*Graphics helps* (male student).

In discussing a feminist perspective in terms of a socio-cultural approach to learning, Rothschild (1988) points out that it 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. This has been evidenced in the past when programs 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).

In examining the classroom environment, this case study uses the concept of ecology that explores the relations of organisms to their environments, where environment includes other organisms with whom the reference species has a ‘symbiotic’ relationship - as in a ‘chain’. Human ecology is the relations of people to their environments (Hawley, 1986).

In environments dedicated to learning, the roles are also epistemological, and it is the discourse between participants that defines the operational epistemology of the group. Learning is clearly promoted when teachers effectively build on students’ prior knowledge and current understandings, for example, by following up on student responses. Discourse in these classrooms becomes a more open ended practice and one of mutual development in which, teachers validate particular student ideas by incorporating their responses into subsequent questions, a process of ‘uptake’.

In examining the female student (S1) in this case study the supportive environment did make a difference to the female student’s growth and participation in the workshop setting. The environment ensured that she had resources and tools that were needed to assist her to work in an area that was unfamiliar.

To analyse activity within classrooms the ecology of learning environments needs further examination. The Siemens (2003) ecology is an environment that fosters and supports the creation of learning communities. In more formal education environments, the concept of self-organizing 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.

It was not a values or career choice that brought S1 to this Technology Education classroom. She saw taking this subject as an opportunity to do something different. S1’s Hong Kong academic records showed she had studied Technology since primary school. As S1 pointed out she had participated in a very different type of Technology based on computers.

H1 and T1 noted that she would require support in the subject and this assurance encouraged S1 to take the class. This was triangulated in her responses saying the teacher knew
and would help her as she was new to the subject. In the final interview questions she focussed less on being new and more on being the only girl with 18 males. She did not articulate this as much in Term 1 but as an observer one could see she was self-conscious and less willing to have her voice heard in the context of the whole class.

The ecological learning environment appeared to accommodate female students. S1 functioned in the environment and yet was able to miss a key learning event without anyone noticing.

The following summarised language in relation to this case study.

### 5.5.3 Language use in classrooms

The language used in the workshop, in the design room, the computer room was specific to the learning that was being undertaken. In reviewing the audio tapes there was general chatter around the workshop after the teacher had provided information and direction to focus the learning on the tasks for that particular day. There was at times a default to referring to the male names. One early demonstration session saw a direct question to the female student but a male student answered for her. There was no stop and pause to wait for S1’s reply. The teacher discourse continued on.

There were technical terms used throughout the lessons and the teacher did slow to provide explanations, not just for S1, but also for other students in the room. Most of the interactions in the room were with the boys. Terms such as ‘well done mate’, ‘prototype mate’ were used by the boys. There was not a lot of interaction between the majority of boys in the class and the female student.

At times when the researcher asked the female student a question, she would not provide an assertive answer. She frequently deferred to the teacher to allow him to answer any questions. Later in the study she was happy to discuss topics around her work but did allow her male peer supporter to answer for her.

The final visit to the classroom saw S1 making more decisions and being able to reply about what she was doing. She was able to articulate what she had done with the letter box and what had to happen during that lesson.
Blackmore (2011) argues that in this era of post masculinity, women need to exhibit strength, strong relations, care and collegiality. S1 did not know many of the technical terms for the tools and felt self-conscious. She did not have a voice in the room and chose not to respond for herself. She spoke with two boys and one was her peer supporter who worked with her in the class. She responded when the teacher addressed her independently, and she asked questions as he circulated the room. S1 responded to the researcher’s questions or her male peer answered for her.

5.5.4 Motivation
In the learning environment, students were encouraged to experiment within defined limits especially in the first project of the year. The limits included time, materials, resources and size as prescribed in the design brief.

The second project - the letter box - saw more scope as long as the basics were covered. The motivation for the female student was to learn new tasks and challenge herself within the supportive environment. The design drawing above left as shown in Figure 5.3 shows what the female student aimed to achieve in design task two.

When S1 reviewed the LED lamp, she indicated that she saw the subject as fun where she could work with friends and learn things about Technology that she may use later in life. When asked about the letter box, her reply was she would create a design and manufacture a letter box.

_‘I don’t need a new letterbox, but it’s good to design;’ was her statement (S1)._ 

The teacher provided a prototype letter box following the design and planning lesson in the technical drawing room. The prototype sat in the workshop and was used at times for discussion and demonstrations (see photograph earlier). The students did not replicate the model
the teacher provided. T1 also demonstrated metal folding and using shears and suggested student should have a metal element in their projects. Few seemed to adopt this idea.

There was motivation on the part of S1 to participate in the class when she made the decision to join Technology Studies. S1 did not have any urgency or drive to produce the artefacts that were to be completed by the students. Given that her reliance was on the teacher then it may be that she would depend on him to produce the work for her.

S1 was guided to do what she was instructed. Certainly her aim was to get each of the pieces/parts correct in the projects. It was not until the final visit to the site that she was openly trialling and experimenting with alternative methods to complete the task.

As discussed in the student section (5.3), S1’s behaviour was not driven by an internal self-value. S1 as termed by Oldenziel (2003) was looking to socially construct her identity by ‘taking something different’, in terms of the course. Through legitimising the differences she brought to the class S1 has repositioned her-self within a social order and brought about a new form of rationality (Wright, 1992).

5.5.5 Role modelling and Peer support

During the interview, S1 noted that she liked to work in small groups, preferably pairs. This was evident from the one male student who she worked with at the benches or outside of the workshop each time the class was visited and they were both present. When her peer supporter was absent, she worked alone.

The teacher provided demonstrations of models and their construction. Given that there were no long term females in the rooms she took queues from the teacher and stated that she preferred the support of a male teacher. There were other female trainee teachers assigned to junior classes. When I asked the teacher about a follow up visit toward the end of the term he replied my visiting made the female student ‘feel special’.

The role modelling which S1 took on was not from her male peer supporter who, like her, had a limited knowledge of the subject area. Her model was the teacher and yet she did not engage in being part of the teaching demonstrations. S1 did not know the traditional pedagogical learning sequence that is part of Technology Education. Hence she failed to understand the benefit of being part of the skills demonstrations.

As discussed with regards to values, S1 did not see this class as a career objective. S1 acknowledged that it would be a life skill. As she said;

*I do not need a letterbox* (S1).

The intrinsic or instrumental value of the artefact meant nothing to her. During the interview with the teacher I pointed out that there were teaching methods better suited to females than males and perhaps this translated into artefacts. He was quickly defensive;

What are they going to make, jewellery boxes? (T1)
This sentiment coincides with the H1’s view of a gender neutral curriculum.

5.5.6 Socio cultural approach to learning

During the soldering of the electrics for the lamps, S1 was not focussed on this task. While the demonstrations were centralised, the students were to apply the techniques to their own artefact. S1 did not seem to understand that she would also have to do this task. Partly, this could have been her lack of confidence or it may have been an expectation that the teacher or a supporter would do the task for her.

Students early on in the course were encouraged and empowered to follow through with their own ideas. Having a notion of what was possible and the extent of what could be done is relevant to Year 11 students. The boys with a background in the subject just went ahead and did the tasks stopping periodically to check in with peers, discuss points and question or show the teacher. S1 did not do this. S1 was task focussed on what she was doing but did not appear to make large amounts of progress to her artefact in the lessons when I was present.

In seeking a model of good practice that effectively engages female students in Technology Education, the literature review examined the ecology of learning. The seven elements were outlined earlier in the analysis by Brunner and Bennett (1997) state that learning should be informal and flexible in a tool-rich environment with opportunities for learners to dialogue and connect. There should be consistency and time to share knowledge. Trust is important for security in a safe environment. Simplicity, around ideas and social approaches to the task was important. The decentralisation of learning that is fostered and connected is important and finally a high tolerance for experimentation and failure.

Many, though not all of these elements, were present in this case study. The earlier discussions supported the notion that trust had been built between S1 and the teacher as well as her peer supporter. There was little time to share knowledge and little connection from one learner to the other except where one student could impart some knowledge to another. This was haphazard. There appeared to be no time for experimentation given time and resource constraints.

Females who enter the Technology Education classes not only stay but achieve at much higher rates than do their male counterparts (H1). The female students are valued and see the worth of the classes once they are part of the class. The issue appears to be the perception from outside that detracts female students from joining the classes in the first place. Perceptions from within the department and the outside community appeared to be at odds.
5.5.7 Values within Technology Education

Values and Technology Education were not a discussion point with S1, T1 and less so with H1. When asked about choices of materials each individual deferred elsewhere as to values and what was taught or taken for granted.

5.6 Summary S1

The impact of classroom environments, whether or not it is from the social or the intended curriculum in terms of socio-economic experiences and exposure to learning, does have an influence on what students choose to study in schools. Life experiences and vocational aspirations of students will further contribute to their choice of subjects and potentially the depth of their engagement in classes such as Technology Education. The socio-cultural factors will in turn shape the contextual area of this study.

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)

The case study has illustrated that the classroom ecology is a key factor to female learners and their participation. The support in an unfamiliar environment by both the teacher and the HOD has been the key to this particular student functioning in Technology Education. The other key support was having someone to work with, the peer support from the student point of view was more critical than mastery of the task at hand.

5.7 Emerging findings

The following are the recommendations for action based on an analysis of the results presented.

The focus for the Technology Department in the school was the ‘take-home-ability of products’ (family and parent appeal of the artefact), in the words of the HOD. This concept appealed to the parents of students in this school setting. The concept provided for the social, creative and cognitive aspects of female learning. A finished artefact provided the reflection and discussion for the female students to engage in that would demonstrate knowledge, goals, and values as well as the aesthetic of what they had produced.

The second finding was that teachers believe they have engaged with a gender neutral curriculum. No matter how good the programming or how robust the planning, this is not a viable practice. There is a need for female oriented pedagogy with an awareness of a need to teach concepts of higher order thinking and project management. This also suits some males (Brunner, 1997; Paechter, 2007). Learning, thinking skills and physical skill development are
enablers of learning and equippers of future learning. These practices would cater to the voices of the females and their dissatisfaction at some of the templates provided to them.

Thirdly, Technology research from Europe (Murphy, 2009) report that it is difficult to overcome stereotypical values on the part of parents and teachers. This study has demonstrated that students, in limited numbers to date, can overcome the historic stereotypes.

The fourth finding suggests that students need to know where the subjects lead - into university and outside courses, trades and life skills. This is relevant when female students make subject selections. It should follow that a broadening of information around Technology Education within the school community may increase female acceptance of the subject and in turn the intake. Advertising and promoting the potential for Technology Education to females as participants is key to engaging other female students in the Technology department. If Technology departments provide adequate time to foster skills in the junior females in order to function confidently in the workshops then perhaps more females would continue in the subject. Employing female teachers as role models and utilising peer groups appear to be critical to female student engagement.

Female students in limited numbers, to date, can overcome the historic stereotypes if they are motivated to achieve in a subject area. The females who did participate in the senior school courses achieved high level results once they found their place in the class and learned the discourse and skills the subject required.

Finally, the study did not find an acute awareness of values and sustainability and a social consciousness around issues such as conservation or recyclability. The lack of awareness of the concept of values or goals at a personal and local level appeared to remove a potential source of knowledge and practicality which female students could have related to and identified within this case study.

5.8 Conclusion

Case Study 1 has demonstrated six points which may encourage female students to participate at greater rates than are currently being seen. Overcoming gender stereotypical behaviour on the part of parents and teachers was an important factor in Case Study 1.

The following chapter is Case Study 2 which is the second of three case studies.
Chapter 6

Having academic conversations in Technology

This chapter presents Case Study 2, a school with an engineering focus, and is the second of three case studies conducted for this research. It presents the results and analysis of the planning and the observations of a unit of work in a senior secondary school setting in the subject area of Technology Education. Case Study 2 relates to two female participants in a large urban secondary school in Queensland. The data are analysed in terms of the themes which emerged from the literature review. Triangulation of data has been achieved through the collection of five sets of complementary data as follows: observations by the researcher as participant observer; interviews with students; interviews with teachers and relevant Heads of Department in the case study; audio recordings and photographs. The analysis suggests that highly motivated students will emerge from a highly motivated environment. Students will overcome barriers in order to achieve an instrumental goal that is part of their positive self-values.

The chapter is structured in the following way. Firstly, details of the study and its context in the school are provided. The results and analyses of each data set for Case Study 2 are presented in order. The order consists of teachers, the HOD, students and refers to recorded audio and visual data. Finally, a summary and conclusion section is provided.

The themes which emerged in the literature review to shape the study are: learning ecology; gender and Technology Education; language use in classrooms; motivation; role modelling and peer-support; socio-cultural approaches to learning and values within Technology Education.

The following provides the results of the study and analyses the collected data under the headings which were identified above which framed the study. Results are provided at the end of each section.

6.1 Case Study 2 - The school

6.1.1 Details of the context

From its inception, this school has focussed on providing education to students who have demonstrated merit. The enrolment policy recognises the school's role as a government high school, and acknowledges its traditions and allied community expectations.

Over many years, the school has built a tradition of high standards in academic, sporting and cultural pursuits. It is part of the Education Queensland’s state school system conducted under the responsibility of the Queensland Government.
The school motto translates as ‘Knowledge is Power’. The school’s aim is to empower the individual to strive for excellence in the pursuit of their goals by providing them with multiple opportunities to excel in academic, cultural and sporting arenas.

The average year level cohort of slightly over 500 students means it is a very large school. The school employs a variety of selection criteria for prospective students, maintaining a quota for local area enrolments, however, also using selective academic, sporting, cultural and artistic criteria as means for determining the annual intake.

In conjunction with the Technology department, the school focuses on university entry and its special programs provide Year 11 students with the opportunity to do first year subjects in engineering at the Queensland University of Technology (QUT) as part of a partnership program.

Aerospace Studies provides direct entry into the University of Queensland (UQ) and QUT studies. The school is a hub for Reverse Engineering Australia Technology. Four scholarships are provided for Built Environment architectural studies students via commercial firms and there are links to study Info mechatronics – robotics and electronics and mechanical engineering with the Australian Technology Network Universities.

The Technology department staff in this school site includes four female and nine male teaching staff. The staff have a variety of backgrounds including subject teaching specialists as well as industry and trades backgrounds. Working to industry standards is key to what all the teachers in the school talk about. They see themselves as working to prepare students for industry as much as for learning in higher education.

There is a higher proportion of female students mixed throughout the variety of Technology Education classes that are offered from Years 8 – 12 compared to the other schools studied. The researcher was able to meet and talk with any of the staff members and most classes were made available to the researcher to be able to enter and view the work that was being undertaken at any time. Expectations of students in this school are that 80% will go on to higher education courses at universities.

As participant observer undertaking an ethnographic case study approach, the study enabled the researcher to look closely at the students involved in the study. It was possible to work beside the female students, and get to know the students. There were no restrictions on photographing the students or recording their voices or the researcher moving about the room and talking to staff and students. Consent had been obtained from parents and the school to do so. The environment encouraged academic rigor and students were aware of high standards that they were expected to meet.
6.1.2 The Year 11 Engineering Studies Class

This class consisted of two female students and 21 male students studying Engineering Technology. The unit was the design, construction and testing of a sign gantry.

The intention of the research plan was to study four girls in each case study site. In this site there were only two female students in the Year 11 class. The adjustment was made to study these two students. As there were other females in Year 12 and Year 10 classes the researcher also visited these groups at the school’s invitation.

6.2 Case Study 2 - Teacher T2 and T3

Data collection in the form of discussions was held in the classrooms and informal discussions with other staff were held in the staffroom and general classroom teaching areas. The staff appeared to be very focussed and enthusiastic in their approach, proud of their department and happy to answer any questions I asked.

Two classroom teachers were interviewed in this site. Teacher 2 (T2) was the main classroom teacher in the class visited. He was a middle aged man with fifteen years teaching experience. Teacher 3 (T3) was a young female teacher with six years teaching experience. Her interview is outlined later in the chapter. The following sections present the results and analysis from T2 and then T3 in Case Study 2.

6.2.1 Learning Ecology

T2 was happy to talk through the interview questions and made time for this to occur. T2 was dedicated to his students and the school and appeared to work well with the staff in the department. His enthusiasm was portrayed in the respect that the students paid him and how intently they took in directions and advice he provided.

6.2.1.1 Results

In terms of the learning ecology, the data collection was comprised of interviews, observations, recordings, and photographs. The data have been examined under the following headings: relationships, gender differences, informality and self-organisation and underlying structure.

6.2.1.2 Relationships

In this classroom there appeared to be a respect by the students for learning and a high esteem for the teacher and his teaching associates who also spent time in the Technology workshop. Students discussed the short term decisions they were making about their artefacts and problem solved within their peer groups. There were days when T2 was absent and replacement teaching staff were present in the workshop. Learning continued according to the students’ individual
plans. The teacher’s pedagogical belief as to an effective learning environment was expressed in the comment:

*Creating a positive atmosphere – where the kids want to come along (T2).*

### 6.2.1.3 Gender differences

T2 appeared to recognise that there were differences between how girls learned and how boys learned but was not willing to speculate on gender differences. He believed the learning environment and the willingness to achieve drove the high achievement levels in the students in his class.

### 6.2.1.4 Informality and self-organisation

The classroom appeared to be informal on early visits; however, this informality appeared to be supported by a sophisticated underlying structure shaped by the assignment work that students were following. There were three features that appeared to support the informality: Firstly, the classroom system was flexible and allowed participants to create according to their own designs. Secondly, the environment was tool-rich, well-resourced and provided opportunities for students to dialogue and connect. Thirdly, there appeared to be consistency of practice and time in the routines of each lesson. In this classroom where students shared information and practices, they appeared to understand their role in the Technology environment. Students were able to experiment and discover what they needed to learn through testing ideas. Trust between the teachers and students appeared to be high as was observed from the social contact face to face with both teachers and other students in the workshop. There also appeared to be a sense of social and intellectual comfort in what appeared to be a secure and safe environment.

In interviewing T2 as to the qualities of a successful classroom, his reply was:

*A academic conversation. Kids being able to talk and discuss what their ideas are and being able to communicate that to other people and to be able to justify it. So students can actually give an opinion. It gets people thinking about why. Okay, why I thought it this way. So those conversations are really, really important. The students have to buy into what they are doing. They have a vested interest in it.*

(T2, interview)

The classroom setting of Case Study 2 appeared to reflect the concept of self-organization. Students appeared to notice very little in their surrounds beyond what they were doing. Their focus in the class was on the task and the machines that were available. Learning and knowledge within the class was regarded as dynamic and not static content as defined by the State syllabus documents.

Learning was promoted by the teacher who built on students’ prior knowledge and current understandings, for example, by following up on student responses. Discourse in this workshop was an open ended practice and one that encouraged the mutual development in
which teachers validated student ideas by incorporating their responses into subsequent questions. This appeared to encourage a process of ‘uptake’. T2 demonstrated his beliefs in practice through having students work collaboratively during the times the researcher was observing his practical and theoretical teaching.

6.2.1.5 Underlying structure

The self-organisation of the students appeared to be underpinned by a more structured process for knowledge transmission and acquisition. T2 could explain where the students were up to and periodically placed various data tables onto the computer screen for students to enter and record their information. Some lessons were begun with a teacher focus, where T2 provided information before students went back to constructing their own models.

6.2.1.6 Analysis

As per the results section, the analysis is under the following headings: relationships, gender differences, informality and self-organisation and underlying structure.

6.2.1.7 Relationships

In examining the classroom environment in which T2 worked, the concept of ecology that explores the relations of organisms to their environments is relevant. Hawley (1986) and Tembon (2008) argue that the ecology of learning in contemporary Technology Education classes embodies the pedagogical strategies that can be used to include more females in those classes. These authors say that unless strategies and effective principles which encourage females to want to be in these classes and complete their studies then nothing will alter. Blewitt (2006) argues that it is the total ecology that includes the participants, the colour of the physical environment, the pedagogy and support, peer support that makes up the total working environment which needs to be considered. Many of these factors existed in the learning environment of Case Study 2.

Rothschild (1988) argues that simply adding women and stirring will not fix the problem of too few female students. T2 was not willing to enter into gendered discussions but acknowledged that there were learning differences between female and male students. Rothschild’s argument is that essentially the courses would remain unaltered except for having met a random target for the inclusion of females. Rothschild (1988) found evidence of this in the past when programs to increase the enrolments of female students have been implemented. The short term target is met, but the long-term results are the same or lower than the starting point. Tembon (2008) argues that change, which will engage females in technical classes, needs to be systematic and long term In order to change the composition of the classes in the long term effectively, there needs to be engagement by the teaching staff with the issue.
6.2.1.8 Informality and self-organisation

Pedagogical ecology identifies the relationships of instructors and learners in learning environments. The learning environment in this classroom did represent a unique pedagogical niche with respect to the learning ecology it reflected (Brunner, 1997). Ecological niches are far more idiosyncratic, dynamic, and variable than the ecosystems of which they are a part. 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 (Nystrand et al., 1998). In environments dedicated to learning, the roles are also epistemological, and it is the discourse between participants defines the operational epistemology of the group. In terms of this analysis it is the interwoven systems which support one another, teacher to student, student to student that shapes the ecology.

Siemens (2006) identifies seven components of a knowledge sharing environment. The seven areas are: informal, not structured; tool-rich with opportunities for users to dialogue and connect; consistency and time in terms of a constantly evolving environment; trust with high social contact in a secure and safe environment; simplicity in simple social approaches; decentralised, fostered and connected; and a high tolerance for experimentation and failure. It is these components that foster and support the creation of communities that are relevant to this analysis.

A learning ecology is an environment that is compatible with how learners learn and this is the key to providing success for students. Brown (Brown, 2000; Brown et al., 1989) defines a positive knowledge ecology as an open system, dynamic and interdependent, diverse, partially self-organizing, adaptive, and fragile.

One key point is the diversity which encompasses female learners and the self-organisation which teachers T2 and T3 noted as characteristic of the learning styles of female students. It is thus interpreted as a learning ecology characterised by: a collection of overlapping communities of interest; cross pollinating with each other; constantly evolving; and largely self-organizing (Brown, 2000; Brown et al., 1989) which appears to best accommodates the needs of female learners. The female students did solve their own problems following the school learning sequence, however, Siemens (2006) suggests that Brown’s analysis on its own is too limiting for modern learning ecologies. The criteria as listed by Brown were reinforced by what T2 explained as his pedagogical beliefs around learning in this environment. Students looked to one another in the workshop setting to problem solve and for support. While it can be argued that such features in these environments will work for both genders, it was the power of discovery and being able to build one’s own meanings, debate and discuss with others that
fosters the positive female attitude toward Technology as a social function that Brunner and Bennet (1997) claim is key to an effective environment.

T2’s approach is interpreted as providing a student-centred social constructionist style of classroom organisation. While not appearing to discriminate for female learners T2 enabled them to, as Wright (1992) concludes, legitimise the principle of difference and how they would meet the needs and wants of their social commitment to the learning. This is consistent with Knopke’s (2012) argument that pedagogical considerations are critical to sound gender-balanced curriculum design. In addition Brunner (1997) concluded that there are instructional methods, learning styles, and interests that can be characterized as distinctively female. Learning in a community that is a student-centred, with a social constructionist style will encourage female teens to engage and grow. These findings are consistent with those of the study of Weber and Custer (2005) who found that females’ preferences for designing learning experiences and males’ preferences for utilising learning experiences were consistent with gender stereotype research.

6.2.1.9 Underlying structure

As argued by Brown (2000), the classroom environment in Case Study 2 represented the elements of a powerful learning ecology. T2 set a high standard for students to strive towards while at the same time providing an engaging environment for students’ learning. It was this learning ecology which was supportive of the female participants. It was framed by trust and interdependence of both teacher and student participants. In addition the flexible and adaptive environment was supportive and challenging and contributed to the establishment of the environment that nurtured the female participants.

6.2.1.10 Summary

In terms of the learning ecology, many elements that engaged and provided agency to female learners existed in this setting. These included the positive and supportive teaching relationships between staff and between staff and students. These were underpinned by the social constructionist style in the classroom. Siemens (2003) seven criteria of ecology contributed to the pedagogy which shaped this learning environment. Hawley’s (1986) argument that it is the relations of people and their environments that make up human ecology that contributes to the supportive learning ecology is evidenced in this case study. The underlying structure of the learning environment appeared to contribute to the success for the female students in this classroom.

The following examines the second of the themes in the study. Gender and Technology Education are viewed under the headings of learning styles and single sex classes.
6.2.2 Gender and Technology Education

6.2.2.1 Results

6.2.2.2 Learning styles

There were clear indications of particular attitudes by T2 based on gender. When discussing the level of dedication and application to task the students displayed in the class, T2 noted the difference in learning styles between females and males:

*With females you can actually give them a project and they can actually decipher that there are steps throughout the whole thing and girls can actually do that and process those thoughts whereas boys can’t do that. You can’t give them a whole project and just say go for it (T2).*

However, T2’s belief is that the tasks were sufficiently non-gendered not to matter. However, from his experience T2 believed that male students, unlike female students, needed to receive information in pieces as evidenced by the following comment:

*Yep. Step by step with the males definitely, but the females can actually process it a lot easier than the males. Some males can be but on the whole you have to lock step it for them. So that’s the biggest difference I see with females and males (T2).*

6.2.2.3 Single sex classes

When asked about the possibility of increasing female numbers coming through from the junior school because of the type of Technology and Design program being offered in the junior school (ASPIRE) and whether that could change the nature of the classes, T2 agreed. However, the possibility of an all-female class was regarded as unlikely, as noted below:

*What about an all-female class? (R)*

*No the school wouldn’t do that. Because of the mixed nature of every class (T2).*

The discussion went on as to whether a class of all females would be a very high achieving class, or whether the females would lack learning things from the boys that they do not know. *There would be a lack of skill sets – there are pluses and minuses but I can’t see it happening (T2).*

6.2.2.4 Analysis

The following analysis relates to learning styles and single sex classes.
6.2.2.5 Learning styles

Belenky et al. (1986) argue that females have different learning styles. This is consistent with T2’s beliefs about the different ways males and females learn. However, T2’s conclusion appears to be that females are more self-directed than males as evidenced by the comment:

As an experienced teacher, T2 acknowledged the difference in the gendered practices of students engaged in Technology Education projects. T2’s beliefs and actions were consistent with the findings of Banks (2009). Research on gender by Hackett, Amsterdamska, Lynch & Wajcman (2008) illustrates that routine approaches should be followed but practical work in mixed groups in the workshop right from day one. Secondly, females will achieve better results and if the tasks are specific to them rather than the single or mix sex groupings.

Banks (2009) examined the causes of the gender imbalance in traditional wood and metal craft subjects, which was a situation that continued in the United Kingdom until the introduction of Technology for the upper years. He summarises research that found there was a gender bias in classrooms and workshops, that there needed to be further strategies for improving the participation of women and that women have the potential to influence the nature of technology.

The responses from T2 suggesting that females operate differently to boys are consistent with Hattie’s (2009) meta-analysis studies showing differences in personality development where girls reach milestones earlier and they remain stable in early to middle adolescence. “Girls display a strong ability to manage and regulate their attention and inhibit their impulses” argue Else-Quest, Hyde, Goldsmith and Hulle (2006, in Hattie, 2009, p 56). Females can project manage. Boys need lock step processes to progress. Hattie’s conclusions are based on the city studies of Cohen, 1991 in (Hattie, 2009) which claim there is little gender difference and that mathematically talented girls and reading talented boys can be overlooked given the adults’ (parents and teachers) beliefs and expectations about sex differences in these areas. Hattie claims overall sex differences should not be of major concern to educators. The problem here is that some of the meta-data analysis is based on studies of adults ( principals) rather than youth (Hattie, 2009).

Single sex classes were not seen by T2 as a concept which the school would consider despite the teachers recognising the ability of the girls and their need for peer support. Whilst the concept was viewed as one that did not equate to the equity issues of state schooling it was not beyond the ability of T2 to suggest a single sex class if the numbers of female students were present. Other schools have had these classes as recently as the year prior to this study.
6.2.2.6 Summary

In terms of gender and technology, the perceived lack of technical skills among the females in the class appears to be balanced by their superior ability to plan and manage and organise their own learning.

6.2.3 Language use in classrooms

6.2.3.1 Results

The teacher (T2) did not regard the use of language as a discussion point. In his interactions with the students, T2 rarely used overtly gendered terms. In one or two cases where T2 called for attention he used the term gentlemen, but, for the most part, his dialogue was non-gendered. T2 saw the use of language as only technical and related to the context he was teaching in and not part of a superior gendered interpretation. T2 explained technical points and terminology in the overhead examples he showed electronically on the white board in the classroom. T2 then modelled the style of language the students would use in a report style assignment. It was up to the students to investigate any specifics they wanted to know by following the investigative process that was employed in the course. This was either through asking someone else, checking on the Internet, which was readily available, or, as a last resort, asking one of the teaching staff.

6.2.3.2 Analysis

The use of language by T2 is consistent with the Technology teacher’s beliefs in the non-gendered use of language. This belief aligns with the public school philosophy that the staff will cater to all students in a non-discriminatory, non-biased, non-sexist manner. The use of male hegemonic language that is accepted as the cultural norm and not seen as extra-ordinary have not overcome the bias practices through language use in this setting. The responses from T2 are at odds with the literature, such as Spender (1980), Belenky et al. (1986) and Talbot (2010), in arguing that, in a majority of mixed gender classes, the default remains with male gendered language. It may be that the male teacher believes he is using neutral language due to the success of the setting. However, Talbot (2010) argues, as does Spender (1980), that there is no non-gendered language, just as they argue that there is no non-gendered curriculum. This is consistent with Eckert and McConnell-Ginet’s (2003) conclusion that gender is a set of practices through which people construct and claim identities, not for simple categorisations, but as part of the process which makes them individuals. As Eckert and McConnell-Ginet claim, gender practices are about managing social relations. Therefore, there can be no promotion or retention of female students, unless the linguistic practices of the teacher alters to cater to female students.
6.2.3.3 Summary

In terms of language in the classroom, the perceived use of non-gendered language in the class appears to default to male terminology, with associated concepts of superiority and acceptance of social norms that have not yet been overcome.

The following examines motivation as it applied in Case Study 2.

6.2.4 Motivation

6.2.4.1 Results

In discussing motivation and the qualities of a successful student the teacher stated that:

\[
\text{...they [the students] are driven. They’re willing to learn; they’re open to conversations and have a passion for the subject (T2).}
\]

When asked whether motivation for the subject was simple passion for a subject they enjoyed or for the purpose of using the subject as the basis for future learning or a career, the teacher responded:

\[
\text{Not all subjects will take them [the students] places and he ‘reckoned’ that even if they have a passion they may not follow it through. The main thing is that they have a vested interest and that they can see a benefit from it [technology] and an educational benefit to what they are doing (T2).}
\]

All students were highly motivated to attend the classes, both in scheduled lesson times and out of school time. They were focussed on achievement in Engineering Technology and aimed to achieve for the collective good of everyone in the class as much as their individual self-interests. For example, one male was late organising his work, because he had to design and redesign in the early weeks of the project. He started building but was behind the pace of the others. He asked for advice from the researcher but did not disturb those students who were at critical points of their work. Some students did provide verbal advice for him while they worked. He seemed overly concerned about his progress. The researcher questioned him about his concerns and received the following response:

\[
\text{It is about letting everyone else in this and equivalent classes down. If I do not achieve then the overall rating of the classes (collective) will come down (Year 11 male student).}
\]

The peer responsibility and accomplishment factor appeared to be an important consideration for all the students. This notion was discussed with T2 later and the teacher nodded and reiterated that this was an academic school that would maintain its standards and all parts contributed to the whole.

The students in the workshop classes were observed assisting one another as part of the process of learning that was taught in the school. Find out, research, ask someone else, ask an
Expert, was the mantra that was repeated. The teachers were present to assist but not inhibit or dictate the learning. The teachers encouraged, guided and made space and time in the workshops available for all students. In turn the students worked hard to meet the expectations of the Technology department staff. For the students, the challenge of the investigation and the mastery of understanding and performing a task, became a motivational factor in itself.

It is argued that the flexibility and allowance for different learning styles in this context catered to the female learners. Wajcman (1991) argued that, “what is central to the social construction of the engineer is the polarity between science and sensuality, the hard and the soft, things and people” (1991, p. 145). The notion of social construction draws on the wider system of symbols and metaphors which identify women with nature and men with culture. Wajcman (1991) goes on to argue that it is the notion of masculinity that is used to legitimate the exclusion of females from engineering. The process whereby the students themselves assisted one another as a learning method can be interpreted as one motivating factor that was part of the community of interest as argued by Wenger and Trayner (2013). Pintrich and Schunk (2002) argue that goal theories such as Ford’s Motivational Systems Theory provides a theory on motivation that is future-oriented (anticipatory) and evaluative (rather than instrumental). Forde (1992, in Pintrich and Schunk, 2002). Pintrich and Schunk (2002) see motivation as the energy and direction for one’s behaviour. Forde’s theory seeks to integrate other motivational theories in a framework that embeds the individual in the biological, social and environmental contexts that are critical for development within its eco-system. An individual will evaluate and make a decision as to whether to continue or stop (persist) an activity when they compare it to other cognitive and behavioural means for action. This is an instrumental value that can be interpreted as a motivational goal.

Pintrich and Schunk (2002) argue that, if students have a means for action in order to function in the workshop, they have knowledge of what skills are required. Mastering the skill is the second component to engagement ahead of the evaluation as to whether students will stop or persist in an activity. The results of the study appear to show that it is the success factor which the skills mastery has led to, which provides the longer term motivational goals. This appeared to be a rich and motivating learning environment and one where the students were well aware of the potential for them.

Learning in a community for the collective good became a driving factor. Whilst the observation is not gender-specific, the outcome is a learning community that encompasses all participants and their understanding of their own individual contributions to that community.

Hattie’s (2009) claims that females internalised their motivation and took responsibility for their learning are supported by these findings. The motivation of all students was evident from the observations of the students in Case Study 2 and the motivation for some students
appeared to be based on a view of where the Technology subjects could take the students in the future.

6.2.4.2 Summary

In terms of motivation, the learning environment created by the teachers assisted the female students to master the skills they required to complete their projects. In addition, the female students were catered for in terms of the acknowledgement and support of alternative learning styles and sharing of information which assisted other students for the collective good of all the students. Engaging and excelling was an important motivational feature that stemmed from the perceived importance of the collective good.

The following examines the fifth theme of role modelling and peer support.

6.2.5 Role modelling and peer support

Role modelling and peer support is reviewed under the following headings: role models, peer support and informal cross grade peer support.

6.2.5.1 Results

6.2.5.2 Role models

The school had four female teachers in the Design and Technology department. T2 and each of the female students interviewed, at some point suggested the researcher talk to T3, one of the junior school Technology teachers. The female teachers appeared to be well respected by students and staff and mixed with the students in the workshop and computer rooms. From what was observed the female staff appeared to provide agency and a powerful positive female role modelling effect for all the students in the Technology department across the grade levels that the researcher interviewed. The female students, from both the junior and senior school, had a good knowledge of the skills of the female staff members in the department and there was an openness of access to them and all the Technology staff.

6.2.5.3 Peer support

Observations of students in the workshop showed that their work was individual in nature though some of the construction problems and solution finding were shared amongst students at the same workbenches. The Year 11 girls relied on one another for peer support and the class teacher if they reached an impasse. The opening of the rooms to the mix of Year 11 and 12 girls meant that there was an important sharing of skills and knowledge through what the teacher facilitated. A Year 12 female student worked on her bridge at the same desk as the two Year 11 female students. There was a sharing of ideas and suggestions that appeared to come from the
greater experience of engaging with the Year 12 student. The two Year 11’s followed her advice and both were able to advance in modifying the joining and strengthening attachments on their own artefacts.

6.2.5.4 Informal cross grade peer support

The workshop was open from 7am on two mornings per week. Students could locate themselves anywhere in the workshop. One Year 12 girl near the Year 11’s was able to suggest how they could better connect their balsa and glue. She shared some skills and provided examples and the students were respectful of her position and ability. The teacher explained the path this one Year 12 girl wished to take in terms of getting into the University of Queensland Engineering for one year then onto Royal Melbourne Institute of Technology (RMIT). This student had a clear values and vocational path that was understood by the teachers and the female students. Her role modelling had the respect of both staff and students.

6.2.5.5 Analysis

The analysis has been written under the headings of role modelling, peer support and informal cross grade peer support.

6.2.5.6 Role modelling

The strong community of practice identified by Lave and Wenger (1991) appeared to be present in this site and is interpreted as a key factor which provided support, success and motivation through positive role modelling for the female students in Case Study 2. It is concluded here that this was a direct result of the presence of the female staff and their interactions with students.

6.2.5.7 Peer support

The results are contrary to Hattie’s analysis of multi-grade classes, where he concludes that there is a “deeply embedded grammar of teaching that remains the same regardless of the structural changes to a class” (Hattie, 2009, p. 93).

6.2.5.8 Informal cross grade peer support

Lave and Wenger (1991) shared learning argument was evident in the early-morning classes. They were not formal, but rather an informal grouping of students, both male and female, however, analysis of observations of the female student’s learning show that there was significant amounts of learning interaction occurring to conclude that these informal peer support opportunities were important in supporting the female students. The shared learning opportunity enabled a greater number of female students to cluster together and share their
learnings in a multi-grade setting. Petrina (2007) argues that teachers undervalue this factor, however, in terms of learning theories Technology constructivists suggest that knowledge is less determined than constructed as Marx would argue (i.e., we construct knowledge as we please). It is argued here that the willingness of all the female students to participate in this community of practice and co-construct knowledge is because of the agency Technology affords them and is a significant finding for this study.

The open workshops where students from various year levels worked together provided outstanding role modelling scenarios for the Year 11’s. Mason and Burns, (1996) in (Hattie, 2009), argue that teachers rarely capitalise on multi-grade or multi-age arrangements to promote learning from peers. Instead, teachers tend to teach distinctly different curricula, maintain grade levels, and deliver separate lessons to each grade-level group.

6.2.5.9 Summary

In terms of role modelling and peer support the sharing of workshop space facilitated the learning of the female students as did the presence of the female staff. The staff members provided agency for the female students. The informal learning between female students was a factor which was facilitated by the multi-level arrangements and open access which benefited the students and their engagement levels in the learning activities.

The following examines the socio-cultural approaches to learning.

6.2.6 Socio-cultural approaches to learning

6.2.6.1 Results

The teacher aimed to promote a positive atmosphere where the:

*Kids’ want to come along and learn. That’s a big gig (T2).*

T2’s comments were relevant in terms of the pedagogy that was used in the class. The beliefs of the staff in this department and school set the socio-cultural tone for engagement with the students.

T2 appeared to display a relaxed notion to teaching in the workshop. Closer observation and further engagement with the class over time showed that the environment was carefully established and structured. This is consistent with the structured organisation which allowed flexibility and self-direction on the student’s part. T2’s pedagogy echoed that of the school ethos that students: given the right environment, would want to and be able to achieve in Technology Education. This teacher did not provide answers but set the structure for students to engage with and succeed in finding what they needed to know via the resources and web links made available.
The school had forged links with QUT and UQ in the area of Engineering. The links established two female scholarships yearly and direct path entry for students from this course. The community in which the school is set and from where the students are drawn have high expectations of the students and the females in this area were no exception. Many parents came from professional fields and held high expectations for their offspring. In this multicultural community the expectations on the female students appeared to be no less than of those placed on the male students. The socio-cultural setting shaped the learning.

6.2.6.2 Analysis

Marsh (2008) writes of achievement motivation in an Australian study by Marks and Creswell whereby the establishing of a classroom climate where students know they can make mistakes and take more personal responsibility is a key factor to success (Marsh, 2008). It is argued that it is the socio-cultural factors that appear to have a positive influence on students.

The socio-cultural impact of family influences on the students in this study cannot be overlooked. As Papert (1980, in Petrina, 2007) argued from a constructionist stance that children do not get ideas, they make ideas. They are likely to make new ideas “when actively involved in designing and making an artefact” (p. 178). Consequently, Papert’s argues that, “if cognition is dependent on the manipulation of the world, then why not give students things to design and manipulate in school?” (p. 178). This study advances the same argument in claiming that the impact of classroom environment of interest and involvement and the future view which T2 has established for the class, from what the students learned, has provided life experiences and vocational aspirations for the students to follow. It is difficult to measure the impact of the classroom environment on student learning. However, Autio (2013) claims that the development of self-confidence and expectations for success will give value to the options available to young females today. It is concluded that these influences, which may come from the social or unintended curriculum, reinforce the positive learning environment for the female students. Therefore this study argues with Marsh (2008) that it may be that the variety of socio-economic experiences of the students which support the argument that the background environment of a student has an important influence on what students choose to study and achieve. Classrooms do influence students but so do the cultural and family/home backgrounds as asserted by Papert and Harel (1991) and Marsh (2008).

6.2.6.3 Summary

In terms of the socio-cultural influence on learning in this classroom, the social expectations from the local environment and family along with their own self-confidence enhanced the ability of the female students to engage in Technology Education.
6.2.7 Values within Technology Education

6.2.7.1 Results

During the interview the teacher asked the researcher what she had observed in terms of values expressed by students in Technology studies. The researcher responded:

*I started off with the idea that the kids [students] might have some ideas on values on materials and is it sustainable. It isn’t a feature of what kids see. Like here the students didn’t really waste materials, here they knew more about what’s the value of us doing this rather than why aren’t they using something else? I didn’t get any depth on that when I asked, Oh could you be doing that with something else? (R)*

*Oh nuh, is the general student reply.*

*It [values] seems to be a general thing that isn’t relevant to these students (R).*

T2’s reply was:

*I guess it’s more in Tech studies where students actually have a choice of materials whereas in engineering to simulate the materials that you use outside balsa wood is nice and cheap, it’s easy to use, the properties of the materials that we are after to utilise that in the classroom situation is nice and easy (T2).*

Researcher:

*What I liked and what was the good thing, and I asked one of the boys, you know when they had to trade in their wood. At least there was some value in being accountable rather than seeing bins filled up with wood. I asked the teacher did he think there is some value in doing this?*

The reply was:

*Hmmm maybe. Yeh, this is a value because I am conserving this [the wood], and that’s one of the things I was trying to get towards but I haven’t seen a lot of it in the kids. (T2)*

Values in terms of the environment and use of materials and why students were doing what they were was a notion that students expected to find in students, based on research by Pavlova (2009). Few students had any concept of sustainability or the value of what they were using or doing. It was not discussed in any detail or with a clear understanding by the students.

The teacher then explained that the students had to do their graphs and weigh the structure….and then actually see how much any changes they made would affect the result for their over-all design.
6.2.7.1 Analysis

The conclusion drawn from the study is that students didn’t have an overt sense of values. Pavlova (2009b) argues that the values of youth are more related to pragmatic values than internal intrinsic, altruistic values. The teacher appeared to want to refine what the researcher was looking for in the interview question before providing an opinion on values that related to the students and teaching within the Technology Education course.

In this thesis, values are interpreted in the same way as Prime (1993, in Pavlova, 2009) has defined them. That is, values are both cognitive and affective. In his reply T2 said: *The ecological and environmental concept of values needs to be revisited in this generation of learners* (T2). It is then argued that while the teachers have learned the concept of environmental values they presume it is known. The conclusion drawn is that this concept is being bypassed for this generation of learners. Students were able to ‘trade in’ their left over pieces of wood for other sized pieces or for credit if they had not used it in their artefact. In placing a value on the wood T2 was putting a functional value on a finite resource. This is consistent with Rokeach’s (1973) argument that values that are activated will lead to action.

Pavlova (2009b) argues that if we are to empower students, and particularly female students, in Technology Education it is necessary for the teacher to focus on the unpacking of values in the context of where they occur. In not verbalising values T2 has omitted a significant aspect of the concept of sustainability in this practical class. It was at the point of explanation and verbalisation linked to action that the concept was most relevant. T2 claimed that the sense of value was portrayed in the assignment work. The sense of sustainability was, however, not evident to the researcher when shown the completed female students assignments.

6.2.7.2 Summary

In terms of values within Technology Education the perceived lack of a sense of values among both the male and female students in class appears to be balanced by their functional values of participation and empowerment.

6.2.8 Summary Teacher 2 – Case Study 2

The following summarises the findings of teacher 2. In terms of the learning ecology, many elements that engaged and provided agency to female learners existed in this setting. The teaching relationships staff to staff and staff to students were underpinned by the social constructionist style used in the classroom. The seven components of Siemens ecology existed and contributed to the pedagogy which shaped this learning environment. The perceived lack of skills among the girls in the class appeared to be balanced by their superior ability to plan and manage their projects. In terms of gender and Technology findings the female students achieved outstanding academic results. The reported use of non-gendered language in the class appears
to default to male terminology, including notions of superiority and social norms that have not yet been overcome.

The motivational techniques used by the teachers and the sharing and role modelling amongst the staff assisted the female students to plan and manage their projects. The role modelling and peer support amongst students and the sharing of workshop space with older students facilitated the learning of the female students as did the presence of the female staff. Both groups provided agency for the female students especially at the commencement of the course.

In terms of the socio-cultural frameworks around females these stereotypical influences appear to impact on female students to a greater extent than they do on their male counterparts. This can be attributed to the historic hierarchical role of the social context in which the education system continues to operate.

The perceived lack of a sense of values among both the male and female students in class appears to be balanced by their functional values of participation and empowerment. There was a greater acknowledgement of the notion of values in the females. The lack of overt teaching of values as a course component has been articulated by staff.

The following section provides the results and analysis of the interview with Teacher 3 (T3) in this case study.

### 6.3 Case Study 2 Teacher 3 (T3)

T3 was a young junior school Technology teacher who was educated in New South Wales (NSW) and had a background in design and technology. She had been teaching for approximately six years. T3 had a strong background in designing and a detailed knowledge of the design process. She met with the researcher on the recommendation of the school and the students. The meeting was in an interview situation and T3 was not observed in a class setting. T3 co-ordinated the junior ASPIRE Engineering program. This is a selective program for Year 8 and 9 students who are achieving well in Maths and Science. It is provided with a view to extending their academic excellence into Technology and engineering.

#### 6.3.1 Learning Ecology

#### 6.3.1.1 Results

In talking about T3’s background, she explained she had a detailed knowledge of the design process and how to facilitate its use in the senior learning areas. T3 had been educated in New South Wales and had grown up participating in the design process as a school student. Her early teaching was in this format before she moved to Queensland.
T3 held strong beliefs about the learning through Technology and design. She was asked what students gain from Technology and the ASPIRE Engineering program. Her reply was: *the hand skills are great. They are life skills we are learning but I think the design process teaches you skills that can be used everywhere. It’s about looking at things like how to solve a problem – you have to understand the problem* (T3).

In explaining the four semester units that were taught in the ASPIRE Technology subject, T3 expressed her beliefs through her knowledge of design and Technology and her pedagogical approach to the subject. Entry to this subject is competitive and there are high expectations of the gifted students in the ASPIRE program.

T3 explained that the junior school content was not just to teach Technology and engineering. It was about teaching skills in every aspect of learning. The course was about observing, playing games and analysing existing things to come up with your own design ideas. The essence of design thinking and problem solving was, in effect, the encouragement for students to engage with Technology Education further. T3 regarded the ‘hand skills’ as essential life skills that are not taught elsewhere in any of the school curriculum except in the context of the design process.

T3’s design background and design process knowledge appeared to contribute to her being able to provide a positive learning ecology for the students through the confidence her knowledge inspired in the students. It appeared that she brought the notion of life skills into the junior school course. This knowledge that the students received appeared to enable them to be confident and move into Technology in the senior school areas while recalling the skills they had learned in the ASPIRE engineering program.

### 6.3.1.2 Analysis

Petrina (2007) argues that there are basic skills in Technology Education which are the grounding values for the subject. He continues his analysis outlining the stances of advocates such as the ecologists, and humanists and states that feminists argue for values such as equity, justice, participation, and responsibility (Petrina, 2007). It is argued in this thesis that, while these values are key to the thesis, they are part of the total socio-technical fabric of the learning being undertaken.

It is argued in this thesis that it is the social and creative as well as the physical environments for learning that are equally as important for how students engage and function in Technology Education. Petrina (2007) argues that students will not automatically adopt values or beliefs on the basis of authority or peer pressure but as Kohlberg, 1975 in (Petrina, 2007, p. 73) concludes, “there are stages of moral growth and they are not pinned to the biological growth”. This study agrees with Gilligan’s (1982, in Petrina, 2007) observation that Kohlberg’s
subjects were male and that females will engage more in negotiation, responsibility and caring and the interests of others than will males.

In analysing the junior school curriculum of the ASPIRE program T3 would agree with Petrina’s conclusion that teachers need to work closely with their students in order to understand the judgements students make that accompany their technical skills.

Contrary to the writings of Zuga (2007) and Wajcman (1991) T3 expressed the belief of the teachers in the ASPIRE program that the curriculum had sufficient notions of difference already built into the program. In turn they claimed they did not need to work closely to understand individual students and how they learn. In this respect the teachers were missing a key factor of agency in teaching female students.

6.3.1.3 Summary

In terms of a learning ecology that relates to T3, her background is important in terms of the social, creative and cognitive development that claims facilitates and builds confidence and student engagement. These factors emerged from her knowledge about teaching in Technology and design. T3’s strong beliefs were in the aspects of learning that Technology that would engage and provide agency to female learners. The content of the junior school program established a foundation for students to progress in the subject area.

6.3.2 Gender and Technology Education

6.3.2.1 Results

The ASPIRE classes have had a good mix of gender, was the response from T3 when asked if there were more boys than girls in these classes.

When asked about learning styles and whether female students were less likely to ask questions T3 replied:

So you kind of have to predict it…
I’ve had a female who created beautiful work and it wasn’t till later that I discovered she got this kid [another student] to do this…[she was] charismatic…organised… Hey, can you do this…? Her ability to get help without getting someone to do it all for her, without her standing out in the class was part of the notion of female organisation. Interesting in Year 9 because they have been with this group of males for a year and the females will just go – oh you’re a ‘boy’ – you’ll do this for me. It is interesting…watching them change the relationships with the boys (T3).

T3 acknowledged the different teaching strategies which worked for female students in design and technology. She was leading an investigation of other schools in order to adapt best practice processes for their department.
When asked where the female student’s progress to within the Technology department, T3 said:

*A few of the females... rather than necessarily choosing pre-Tech studies have gone into aerospace because it feels a bit safer. Like they’re really enjoying the prac and they’ve gone into aerospace saying okay it’s got some theory and I’ve got something to jump back to. It’s really sweet (T3).*

### 6.3.2.2 Analysis

Providing choice, provide agency as an outcome of the junior school classes with equal numbers of males and females. It should follow that this would be an indication that more females could be encouraged to undertake Technology Education in the senior school if there was a motivation for doing so. Zuga’s early works cite the identification of masculinity with Technology which transmits meanings and values with machines and technological competency (Zuga, 1991). T3’s conclusion that the female students appear to be making stereotypical gendered choices of going into classes such as aerospace ‘because it feels safer’ and has a more theoretical background reinforced long held practices. It is argued in this thesis that the decision as to whether Technology provides the basis for a future career is based on two competing considerations. On the one hand it could be perceived as involving a safe workplace and thus a safe career choice option. On the other hand it could be perceived as a theory-based academic subject linking to university courses but failing to enter the practical engineering courses.

In discussing female learning styles T3’s comment about the female student who was able to organise the males to complete parts of her work without the teacher noticing: *That’s really sweet,* is not consistent with the strong female support this teacher appeared to voice. This is not the feminist view that Zuga (1991) argues would encourage female engagement ahead of social manipulation.

Knowing that female students will ask fewer questions should enable teachers to make decisions and act on them in practical sense by adjusting the pedagogical approaches to learning as expressed by the studies of Fleer and Jane (2011). It can be interpreted that the learning styles for girl’s need to be addressed in the early years of their education and followed through to their secondary education in Technology Studies. It is argued that catering to these differences appears to make a difference to encouraging females to participate in Technology Education classes in the latter years of their secondary education.

The strategies of making choices that suit female learners and decisions based on safe practices are consistent with the types of project management that female students can and do employ that was noted in section 6.2.2. The ability of the female students to follow steps but organise others to do the work and manage it is evidenced by reports from the staff interviewed in Case Study 2. Making the department in the school the best of those available in Queensland state schools was an important notion which this teacher was implementing. Where female
students transitioned to was an offshoot of their being part of the Technology learning environment of the school.

6.3.2.3 Summary

Choice in taking up the ASPIRE class was important in terms of females taking up technology. Students had to qualify and then enter the course. Developing skills by capitalising on the learning styles of female students was recognised as compared to teaching male students. Building confidence and familiarity appeared to require time before the female students can use their organisational skills to plan and manage their own projects more consistently than the male students. Recognising the difference and catering programs for individuals was not a feature in the junior courses.

6.3.3 Language use in classrooms

The following outlines the results and analysis for language use in classrooms.

6.3.3.1 Results

In working with young but very bright Technology students T3 noted:

*What was interesting about the kids who get into ASPIRE tend not to be good socially so it’s a really good opportunity to teach them to communicate. This happens because they are bright students who don’t like to share their ideas. In the early groups this was more common in the boys (T3).*

6.3.3.2 Analysis

The research by Pintrich and Schunk (2002) supports what T3 noted, that students who qualify academically are not always those who are willing or socially able to communicate freely to problem solve in a group. As T3 noted, the teaching staff in Case Study 2 have adopted teaching strategies to address these issues. While the male and female staff and the HOD claimed the strategies that they used stem from a non-gendered perspective, it appears from the interviews and reflections with the two staff that there were considerations made for the female learners. The analysis appears to show that the actions taken by T2 and T3 are conducive to catering to female learners.

6.3.3.3 Summary

In terms of language in the classroom the perception that the staff engage in non-gendered language is not supported. However, there are adjustments made for female learners.

6.3.4 Motivation

6.3.4.1 Results
The aim of interviewing T3 was to ask two key questions: what motivated the students to achieve in Technology Education, and what factors assisted the female students in this school to achieve? Each time the researcher asked these questions in the school, the reply was, talk to T3. This teacher and her programs in the junior school, were seen as the basis of what happened later in the senior school. In asking what made a successful classroom T3 saw a distinction between the workshop, computer room and design space. Her reply was:

*I think the teacher having some sort of enthusiasm makes a difference. I actually don’t know how much having exemplars helps as far as designs...e.g. with the making of the key ring. My plan was to laser a square but not to show...because once you start putting that in it hinders the design (T3).*

**6.3.4.2 Analysis**

Hattie (2009) argues that student motivation is at its highest when students are competent, have sufficient autonomy, get feedback, set meaningful goals and are affirmed by others. “Females will take on internal motivational factors ahead of males who will externalise their academic achievements” (2009, p. 48). The degree of dedication and enthusiasm of T3 appeared to be important to the students to continue on with Technology Studies in the senior years at this school. Motivation and drive appeared to centre on this female teacher who promoted the physical technological process and activity.

**6.3.4.3 Summary**

In terms of motivation, the techniques used by the teachers are facilitated by the pedagogy that addressed female students’ learning styles. There was choice, decision making and design processes.

**6.3.5 Role Modelling and Peer support**

**6.3.5.1 Results**

During the interview with T3, she reflected on how staff and student peers worked in the classes:

*The staff developed a group work component as part of the course because the students were so competitive. The girls, some of the girls were really quiet to communicate within a group. The boisterous boys – you need to be aware to communicate within the whole group and build that group dynamics. That changes working on the programs later on. Every couple of lessons we build on this idea. ‘Hey this is how a group works, more on this is how we have seen the groups’. If there is a group where two people are doing everything and two people doing nothing we’ll stop and possibly do like role plays. We tend to come up with something – we come up with some really good stuff. And again there’s the design process all built in and I think that’s what the girls like. I think they like that*
freedom to explore what they can really do with it whereas a few boys would like just to be told what to do (T3).

In discussing the work of the females as they entered the workshops T3 noted one female student who picked up everything really quickly: Admittedly, said T3, she was moved out of another class into my class so she was not the only female. The researcher commented that it’s interesting because female students interviewed have said it does not make any difference that they are the only female and yet that’s not the impression teachers in the schools in the study have gained.

With regard to managing students in the class and their peer interactions, T 3 appeared to say that reducing any distractions from the task at hand was important to her as the teacher, rather than addressing issues that may arise as a result of having male and female students, in the class.

When I started a Year 8 class this year I had two rows of girls and they chattered. So I spread them out. It’s actually meant that they don’t even notice that there are other girls in the room. It wasn’t to spread out the girls it was to spread out the talking. There are a couple that sit together and yet when we have gone into the workshops the girls are still on two benches. Doesn’t matter – I don’t think it matters as long as they have got a friend in the class (T3).

T3 noted the current Year 10 group:

There are a lot of girls in that year and yeh, it’s really interesting to see how the girls interact there and then how they interact outside the classroom. Some of them were from slightly different groups yet in class they would work together but outside – ‘Oh no, we don’t talk to them’.

They’d cluster together in the classrooms. They weren’t randomly spread around the room and yet when I said; does it matter? They say, No it doesn’t matter, but they’re all together (T3).

T3 talked of the ability of females to plan, be flexible and apply knowledge to other tasks. This was different to the male students learning a task and sticking with it:

Early on in the year in the workshops the boys will get a process, get a process, will get a process. ...but at the moment (May) in the workshop the boys are finding it [the concept of technology] but the girls are getting lost a little. Because it’s not structured in [ ] how to make it. I’m giving them... ‘This person’s doing this so come and have a look’. With some modelling the girls will get the idea of what to do next. They will move past the dependence as they gain confidence and maturity (T3).

T3 went on to discuss when students see the possibilities in Technology and the products that they can make.

Especially if it is high quality, then there is that intrinsic motivation and so the kid that made it is more proud of it. They will actually want to take it home and actually want to show people (T3).
When asked about the qualities of a successful student as against a successful female student T3 said:

Don’t think I have every really thought about it to be honest and I kind of lump them all together– we just tend to lump them all together (T3).

This statement was at odds with T3’s introduction to the ASPIRE course. To gain a place the students were seen as academic achievers with parental support that these students could enter the program and be supported at all levels.

6.3.5.2 Analysis

In reflecting a theory of feminism as expressed by Wajcman (2004) that has come to embody women’s agency through Technology and explores the effects of gendered power relations and the impacts of making changes, T3 use of role plays within supported and structured programs to model appropriate roles to new students in the workshop and Technology rooms. Such strategies enabled her to monitor individuals. This could be interpreted as non-gendered behaviour except that T3 reports some unique insights about the female students and how they function as opposed to male students.

Belenky et al. (1986) argue that as long as the female learner is capable and confident then it should not be a case of proving themselves amongst other female learners. They can do this in their current context. Moving one female student to the class of the female teacher so that the female students were together appears to reinforce the teacher perception that female students’ receive more support when in clusters. This is not consistent with reports from the female students who argue that they are quite happy working alone in the workshops.

Pintrich and Schunk (2002) report that friendship groups based on shared aspirations to succeed lead to positive learning outcomes. The management strategy that T3 reported of scattering females in classroom settings to reduce chatter (behaviour) but allowing the female students to again cluster together in workshop, in less familiar environments for support appears to be contradictory. Hattie (2009) cites tracking studies in the United States such as Oakes’ in 2005 which concluded that ability groupings (such as the ASPIRE class) foster friendship networks linked to student group membership.

The discussion of the Year 10 females who supported each other in class but did not acknowledge each other outside the class context is regarded as evidence of learning in context. Belenky et. al. (1986) would not endorse the notion that women’s ways of doing tasks need to occur in clusters such as T3 is suggesting. This is a management and support strategy identified by the teachers in the school, however, little capital is made of the clustering notion in terms of Wajcman’s (2004) argument that a socio-technical network which integrates materials and the social elements of Technology and practice will offer women more agency than has existed in the past.
The peer network, as identified by Pintrich and Schunk (2002), and the family reinforcement, appears to be critical in developing efficacy and involvement in female students. It is important to note that once the female students understand the design process they appear to be able to manage their projects and their time. The analysis appears to show that the female students took pride in artefacts and they would seek support from others outside of class for reinforcement and approval of the high quality outcomes they aimed to achieve.

T3’s declaration that she: *lumps all students together* is not consistent with what she had reported in terms of her classroom strategies. Her democratic declaration maintains the idealistic notion of state schooling but not the notion of peer support and modelling for high standards of learning which she claims they achieve. T3’s persistence on non-gendered outcomes is at odds with her claims, but supported by Wajcman’s thesis that equality of the sexes must go beyond the entitlement debate (2004) and include parity in engagement. Role modelling as a process and a means to a quantifiable end appears to be questionable to T3, however, peer support is actively promoted and viewed as a means of engagement for female learners. This was evidenced in her moving one female from a male class in order to have a female peer in the class.

6.3.5.3 Summary

In terms of role modelling and peer support T3 saw the activities and skills development as more important than catering to gender specifics, however, she did acknowledge the need for the female students to work together and the importance of peer similarities, identity and support.

6.3.6 Socio-cultural approaches to learning

6.3.6.1 Results

The following discussion during the interview with T3 came from an interaction about the Technology Department having ended Technology Studies in Year 11 and 12:

*I’m the one that’s devastated…..because I have actually seen the design stuff work, I don’t think that most of the faculty have ever actually seen it work and function. Having been through a department that is all design, I know what it looks like. I’ve seen it (T3).*

In changing the courses the school has targeted its drive for academic achievement over what students can do in practical Technology courses:

*Why did the subject go? (R)*

*Well it went because it was not contributing to Overall Position (OP’s) and they went, ‘Oh we’ll get rid of it’. Chop the tail out so those kids have been forced to go*
to graphics, engineering, aerospace or forced to construction [which is] non OP. Most of them [in] my ASPIRE engineering, loved the Pre Technology Studies (PTS) and could not keep going (T3).

These are real problem-solving type of kids. So that’s why it’s gone. So I have stepped back and said so how do we get those kids in... try to change the clientele who feed into it...so the kids have an understanding of what Tech studies is? At the moment the way we run the junior school is a lot more like construction/ furnishings, which is product based. So with the redesign in mind I went to Sydney Boys High – as an equivalent to us, and because they’re academically selective as well, to see what they’re doing. Interestingly they have gone back to product based rather than process (T3).

T3 believed that the school still needs to be developing skills because society in general needs people to at least go home and hang up their own pictures.

The discussion with T3 moved to where students start in Technology Education and she explained about the designing and cutting of a USB (Universal Serial Bus- computer interface):

So they actually have to research a bit about what a USB is and how to file stuff ... This is the beginning of school this is how to organise yourself. In linking what the program expects from the students: We expect you to have a USB, so we can provide it and you can say you did it at the beginning, you keep it and follow the making process all the way through (T3).

T3 explained that the females in the class loved the activity, the males got a little bit lost… but the females just ran with it:

I have found that in the past when I have had an ITD (Industrial Technology and Design) year eights [class], the boys walk into the workshop and go ‘Cool’ the girls walk in and go ‘owwww’... they are not as comfortable. So it was a nice way to get the students feeling quite comfortable with the course. We were in a computer room but ideally you are in a classroom (T3).

6.3.6.2 Analysis

Hattie (2009) argues that while schools make changes in courses and curricula, the change frequently relates to inclusion and instructional strategies and to the highlighting of learning strategies and skill development in the content area. Hattie’s claim appears to be consistent with the practices of the Technology department in this study. The Technology department is targeting its drive for academic achievement over what students can do in practical Technology courses.

To follow the analysis, there did not appear to be strong support for the school ignoring the life skills aspect of technology. Belenky et al. (1986) argues that women care about things that relate to their lives personally. In highlighting the work of Freire’s problem posing method, (Belenky et al., 1986) included the notion of connected teaching. This is about the “female method of learning and thinking which becomes public and not private dialogue” (p. 219). It is argued in this thesis that the more involvement female students have in something that affects
them personally; the more female learners will seek to explore it. The development of life skills in this case would appear to be a significant factor for engagement.

Wajcman’s (2004) argument is that we should not regard the artefact as more important but rather the process as this leads to empowerment. The analysis supports the notion that Technology courses that aim to engage more female learners should start with linking an item that is to be produced with a real life learning need and its subsequent application. In this case it was the USB making.

Petrina’s (2007) research demonstrated that it is the support of this one group that may be required over another. As in this case, the female students engaged more in a process activity. The results illustrate that the reaction of different groups of students going into workshops differs from males to females. It is necessary for teaching staff to discriminate positively for female students in the lower grades in order to achieve the outcome of higher participation rates in the senior school classes.

6.3.6.1 Summary

In terms of the socio-cultural framework that shapes the engagement of female students, T3 recognised the different learning patterns, modes of interaction in the workshops and social interactions that enable the female students to learn in an environment that was initially, unfamiliar to them.

6.3.7 Values within Technology Education

6.3.7.1 Results

On the topic of values T3 questioned the concept and how it could be looked at. The discussion went; you could look at values two ways. One was in terms of valuing what you are doing, but two in terms of the products being used from an environmental point of view. The wood became the materials.

When the students were asked, could you make it in another material they shrugged.

*It is obviously not a discussion point (R).*

The teacher agreed, not a lot.

*The materials course…. One of the things we look at is….. Sounds like a boring assignment, but they get right into it. They have to work out what timber could be used for a power pole. Some of them look at what other materials. What other timber and they look at the options? For example South Australia makes them out of concrete. Students then look at where can they source the materials from; how’s the transport going to be for that….I don’t know how much of that goes further (T3).*

*Researcher: You would not use the term values?*
The discussion moved to the type of projects that female students have been involved in as motivators for the courses. Did the entry level offerings have social value rather than another value? Were students doing Technology because it has an end (instrumental value)...or are they doing it for the skill or for the process and as reflexive learners.

Well I had one today (T3).

T3 explained that they don’t grade the trebuchet as it is just to give them [the students] experience and an activity that helps to get them feeling more comfortable with the learning activities. They are working off their own working drawings and then they find: oh this is wrong. Oh I’ve cut it the wrong way – why oh my materials list is wrong – why was it wrong – because…then it is them saying oh this is what we are doing and why, which is showing the intrinsic point of, why are we doing this? These points will apply later on:

Really I’m using this timber because it’s easier to work with or that’s going to wreck my machine...rather than this hard timber. They start with a presentation about balsa but not alternatives (T3).

As part of the discussion, T3 acknowledged that she could teach a concept such as values as it applied to the content that the gifted students in the ASPIRE program work on. The investigation as to telegraph poles was the example she returned to and thought more about the applicability of the values concept. The project looked at the type of poles used in the desert in South Australia and why one type would be more sustainable and suitable than another. Students were required to do research to investigate and evaluate materials and their uses in the environment.

6.3.7.2 Analysis

The research of Pavlova and Turner (2007) on Values and Technology, points to values and environmental aspects as important components and concepts in Technology Education courses. These values are ones which could relate easily to female learners. The results from Case Study 2 do not appear to indicate that values, as a verbalised concept, were a part of any developmental aspect of the teaching or learning programs that were viewed in this site. However, activities that were consistent with a values approach were found, for example, the conservation of materials.

Petrina (2007) notes the call by the International Society for Technology in Education’s (ISTE) third foundation which refers to ethics. Ethics is the call to moral action and is the basis for determining and making choices and judgements. The apparent lack of discussion around personal development of problem solving and internal values with the students in this case study appears to point to aspects of teaching that are lacking when targeting females in technology.
The results showed that teachers wanted students to ‘discover their own learnings’, however, the positive results for the engagement of female’s learnings in the junior school do not appear to translate into what T2 discussed in the senior school class.

These findings are consistent with the motivational factors that stem from students engaging in personal problem-solving and goal-setting with respect to procedural knowledge as defined by Petrina (2007). This school with its strong learning community was at a pivotal point in the development of female students in technology. Teaching techniques, teaching females and striving for academic success intersected in a positive manner for the participants. The pedagogy appeared to fail in the transformative task of moving learning for females to a new level as expressed by Wajcman (2004) and Petrina (2007). The social factors of learning and the intrinsic values of self-motivation have provided students with success in this setting. This has involved encouraging reflexive learning while not specifically targeting the female student’s appeals to female style learners rather than male learners. The interview with T3 confirmed the point that Pintrich and Schunk (2002) argue for. That is, that the value of the activity will in turn lead the learner to further achievements.

Ecological sustainable development should provide students with a larger world view which relates to values. Pavlova’s (2009a) research demonstrates that sustainability that is locally relevant and culturally appropriate come from three pillars of sustainability. These are society, environmental awareness and the economy (Pavlova, 2008; 2009a). Each pillar contributes to sustainable development which provides paradigm shifts for educational change. Few of these values appear to have been met on a cognitive or affective level in this case study despite the academic status in learning on this site.

6.3.7.3 Summary
In terms of values within Technology Education the staff member T3, like T2, did not overtly wish to acknowledge notions of sustainability or goals related to them. T3 did recognise values in terms of the relevance to students of particular activities that had an underlying values basis concerned with how they may work with equipment and materials or intrinsic values past those that were career-oriented.

6.3.8 Summary Teacher 3 – Case Study 2
This interview provided valuable insights into the programs and learning environment that shaped the fabric of the Technology department in this school. The experience of the female teacher in working with students and noting patterns of behaviour validates observations made with the senior students and staff in this case study site. Petrina (2007) argues there needs to be a positive effort to accommodate female learners over males in Technology in order to achieve the outcome of more female participation. This study suggests that it is the junior school
programs that bring the students to the senior school. The second inducement is the outcome values that the students hold, the career aspirations and ideals.

In terms of a learning ecology that relates to T3, her background is important for the social, creative and cognitive development that builds confidence in student engagement. These factors emerged from her knowledge about teaching in Technology and design. T3’s strong beliefs in the dimensions that Technology Education could give students appeared to engage and provide agency to female learners. The agency and voice given to the female learners could be heightened. The content of the junior school program has established a foundation for students to progress in the subject area.

T3’s experience in developing skills via the specialist programs she organised for gifted students demonstrated that teaching learning styles to female students is different to teaching male students. Building confidence and familiarity appears to require time before the female students can use their organisational skills to plan and manage their own projects more consistently than the male students. This finding has implications in terms of teaching strategies for gender in technology.

In terms of language in the classroom, the perception that the staff engage in non-gendered language is not supported. While there are adjustments made for female learners changing the nature of the dialogue and use of technical terms would cater to female students.

The pedagogy and learning styles that the staff cater to they claim do not differentiate for gender. It is however, some of these strategies which appear to motivate female learners in Technology Education in this school.

T3 saw role modelling and peer support of the activities as more important than the notion of gender. She did however acknowledge the need for the female students to work together and the importance of peer similarities. Motivated female staff may also provide agency here.

In terms of the socio-cultural framework that shapes the engagement of female students, there appears to be different learning patterns, modes of interaction in the workshops and social interactions that enable the female students to learn in an environment that has previously been unfamiliar to them.

Values and notions of sustainability within Technology Education staff were not overtly acknowledged. T3 did recognise values in terms of relevance to students and how they may work with materials. Beyond career orientation and materials, she did not see values as a single teaching concept.
6.4 Case Study 2 - Head of Department – H2

The HOD provided the access to all his teachers and classes on behalf of the school principal. H2 was a middle-aged, experienced teacher and administrator who appeared to support his staff in all the activities they undertook in the school. The interview questions were discussed in between visits to individual staff and observation of classes. The final responses from H2 were emailed.

6.4.1 Learning Ecology

6.4.1.1 Results

In asking H2 what factors make the Technology Education classes a success for his school, his reply was co-educational classes, great people, a balance of male and female teachers and a futures-driven and up-to-date curriculum and Technology that has industry relevance.

In terms of the interactions and social culture of the class environment, H2 believed that co-education had more benefits than disadvantages - and observed that: *In some areas such as math, research may indicate that boys perform better in a single sex class. In our area, I think this has less of an impact* (H2). H2 saw the success the Technology Department enjoyed being the result of both the overall school experience and the nature of the Technology subjects and the experience of the staff who delivered the courses.

6.4.1.2 Analysis

Wenger (2006) describes the collective learning experience in a shared domain of human endeavour as a positive one which is expressed through enthusiasm [by all participants]. H2 understood the importance of the school community and the Technology teachers providing a positive learning ecology, however, the importance of some aspects of the learning ecology in this community of practice did not appear to be fully recognised by H2. The enthusiasm for the Technology learning area and the school was apparent in the successful engagement of all the participants in the Technology department. This was the only site in any Queensland state school with a large number of female staff and students engaging in Technology Education. This phenomenon would appear to have provided the Technology classes with an unparalleled learning ecology; however, H2 saw no difference in terms of learning ecology between the female and male staff.

It can be concluded that H2 believed that mixed classes made the learning the success that the students experienced in this site. Using Eckert and McConnell-Ginet’s (2003) argument, it can be said that H2 believed he has built a non-gendered ideology for his department. While the H2 focussed only on the non-gender specific nature of classes, he did not highlight the
supportive nature of learning and the learning from one another. He did note the motivation that appeared to result from students responding to the school ethos to excel. This thesis suggests that the lack of recognition of overt feminist agency was an opportunity missed for the long term inducement of larger numbers of female students to engage.

6.4.1.3 Summary

In terms of the learning ecology H2 had led the establishment of what appears to be a one off, unique learning environment for female students in Queensland state schools. The drive to excel in an academic environment and the embedding of Technology Education within this setting appeared to heighten the status of the learning in this department.

6.4.2 Gender and Technology Education

6.4.2.1 Results

H2 reported that he made a conscious decision to employ female teachers. *Timetabling for the staff is not done any differently regardless of their gender* (H2). In responding to the question about the characteristics or qualities one would look for in a female who wished to participate in Technology Education H2’s response was:

*The same qualities for a female as for a male. Dedication and passion for the profession and an eagerness to keep learning and of course the ability to teach and be an expert in the context area (H2).*

6.4.2.2 Analysis

There was an acknowledgement from H2 that female staff may attract female student participation and this was reflected in the conscious decision to employ female Technology teachers. What H2 then claimed was that there was no further recognition of gender. Drawing on Eckert and Mc Connell- Ginet’s (2003) the contrary is argued in this thesis. Given that the school and the Technology department have actively recruited female teachers. A strong connection must be made between gender and the notion of role modelling. Zuga (2007) and Wajcman (2004) argue that the acknowledgement of what H2 has done is to position the females in the school in a more positive light than has been done in the past. This study posits that the female teachers have been provided with a voice in the context of Technology as a subject, but not a feminist voice according to the results provided by H2. It is argued in this thesis that the presence of the female staff members appear to have provided positive feminist agency for the female students and other staff.
6.4.2.3 Summary

In terms of gender and Technology Education, the acknowledgement that female staff provide agency and empowerment to female learners appears to be upheld. In actively recruiting and selecting female teachers, the Technology department has provided positive role models, empowerment and agency for female students.

6.4.3 Language use in classrooms

This was not discussed in the course of the interview, however, in general, H2 would say that the staff use non-gendered terms in keeping with generic nature of public education.

6.4.4 Motivation

This was not discussed in the course of the interview with H2. H2 believed this was part of the total school ethos led by the school motto.

6.4.5 Role modelling and Peer support

6.4.5.1 Results

To address the issue of role modelling and peer support, two questions were asked. The first was concerned with the level of importance H2 placed on the engagement of females in this subject area. A second question was concerned with whether H2 thought role modelling and peer support were more important for either students or teachers. H2 saw it as equally important for males and females:

*We have done a great deal of work in ensuring the work is not bias to any one gender. Students look up to great teachers as role models, so I think it is very important to have both male and female teachers. Obviously having more female teachers in the area allows female students to recognise that it isn’t a male dominated subject (H2).*

6.4.5.2 Analysis

Petrina argues that:

*Equity refers to qualitative concerns for fairness and justice. To address equity we may have to demand unequal treatment (as equal treatment is not always the answer). Some groups (i.e. girls in technology) may require differential treatment to have a fair chance to participate and perform.* (Petrina, 2007, pp. 333-334)

The study has highlighted that there is no notion of gender neutrality, but rather an acknowledgement of difference that would bring about an equality of entitlement within Technology from H2. Talbot (2010) argues that in representing gender as difference, gender categories are at times seen as opposites or complimentary pairs. H2 appeared to believe that the female staff provided a role model balance for both students and staff and his claim was
consistent given the respect that was accorded to all in this learning environment. As such Talbot (2010) argues that when representations of gender are seen to offer solutions to gender problems they will in turn reinforce gender stereotypes. Talbot (2010) argues that, “It undermines the emancipatory aim of feminism” (p. 109). In this respect, H2 has made a decision which will, according to Talbot, better bolster the engagement of females ahead of the acknowledgement of difference which Petrina has argued for (Petrina, 2007).

6.4.5.3 Summary

In terms of role modelling and peer support, the presence and availability of female staff provided active social support and role modelling for female students. The mixed year level classes that occurred outside of formal teaching times further enhanced learning for the female students in terms of peer support. In terms of Talbot’s (2010) argument, H2 has been successful in putting strategies in place that address gendered issues while minimising the negative aspects of stereotyping.

6.4.6 Socio-cultural approach to learning

6.4.6.1 Results

In response to questions of gender and teachers, H2 responded:

Some teachers are better at catering to both genders and engaging all students. Some teachers feel more comfortable amongst a group of one gender than the other (H2).

H2 believed that it was up to the person’s (teacher’s) interpersonal skills and their experiences though life, as argued below:

I don’t think one can make the assumption that a male teacher caters better for boys or vice versa for female teachers. It is an individual trait that people have (H2).

The Technology department staff reflected the multi-cultural diversity of the school. The staff appeared to have an outlook that believed that all students would achieve with the school website mentioning improving performance, visible learning and a positive culture from the motto Knowledge is Power. The nature of the approach to learning means that all students had opportunities to learn if they choose to take advantage of them. This Case Study 2 was located in what was seen by the community, staff and students, as an academic setting in which individuals were encouraged to strive to excel.
6.4.6.2 Analysis

The environment around the students supports Eckert and McConnell-Ginet’s (2003) argument that if females are supported and encouraged then there will be positive results that empower them to excel and find their voice in the socio-cultural context of the activity. The difference in Case Study 2 is that there was no acknowledgement of actively promoting the female students by way of same sex classes or same sex teachers or positive discrimination as evidenced by the research of Petrina (2007) or Eckert and McConnell-Ginet (2003) existed.

The socio cultural setting of the school and its wide demographic catchment support the argument of Pintrich and Schrunk (2002) that a supported, enriched environment will give agency to students within the community regardless of ethnic or gendered backgrounds. Collectively all students would achieve due to the dominant socio-cultural approach based on the assumption of successful learning for all.

6.4.6.3 Summary

In terms of the socio-cultural approach to learning for this setting, the belief that all students could achieve and would do so because of the collective good of the whole group meant that there was localised as well as group support. Not only did the school have high expectations, but these expectations were backed by families and communities and the future expectations for the female learners.

6.4.7 Values within Technology Education

6.4.7.1 Results

H2 saw that what ‘they’ [the staff of the Technology department] believed in as a school, was portrayed in the learning environment of the Technology department and its classes. The values that the school upheld were those of the State education department and of equity for all regardless of gender. Thus, when H2 commented on values, the dominant feature is the school’s values as shown in the following:

The values embodied in this subject are high expectations, the schools’ core values, learning as a priority and Knowledge is Power that is the school motto (H2).

6.4.7.2 Analysis

Throughout the interview process with H2, there appeared to be no engagement with intrinsic or social values as argued by Rockeach (1973). These notions of values related to the materials used within the subject area and learning activities related to sustainability as well as future uses for engaging in technology. Wajcman (1991) would argue that this belief reflects the extent to which control of Technology is involved in an archetype of hegemonic masculinity. It is in the
values of Pavlova’s research where terms such as sustainability and access emerge. It is the issue of personal values which underlie the feminist perspective and how these translate into education at the local level which relate to this study. Pavlova’s (2009) research discussed the affective and cognitive component of values but went on to add and build on Rokeach notion that values that are activated may lead to action (Rokeach, 1973). Therefore, Pavlova (2009b) argues that decisions made during technological activities will lead to actions. All three components of values should be dealt with by Technology Education teachers.

H2 appeared to reflect the corporate values of the Education Department that were external to the learners, however, his attitude did reflect the dominant ethos and ideological practice noted by Wajcman (1991).

6.4.7.3 Summary

H2 did not appear to engage in promoting the affective, cognitive or active environmental values of Technology Education beyond the corporate values that were embedded in the school and its motto. The practice would not appear to be consistent with what was observed or in programs in the Technology department but was consistent with conclusions drawn by researchers such as Pavlova (2009b).

6.4.8 Summary Head of Department 2 – Case Study 2

In terms of the learning ecology H2 had led the establishment of what appears to be a one off learning environment for female students in Queensland State schools. The drive to excel in an academic environment and the embedding of Technology Education within this setting appears to heighten the status of the learning.

The acknowledgement that female staff will provide agency and empowerment to female learners appears to be upheld by the findings of the study. In terms of gender for Technology Education, actively recruiting and selecting female teachers for the Technology department has provided positive role models and agency for female students.

The use of gendered language was not discussed in the course of the interview however in general H2 believed that the staff use non-gendered terms in keeping with generic nature of public education. Similarly motivation was not discussed in the course of the interview with H2. As per his comments on language, H2 believed this was part of the total school ethos and permeated the total learning environment.

The presence and availability of female staff provided an active social support for female students. The mixed year level classes that occurred outside of formal teaching times further enhanced learning for the female students and provided positive role models and peer supporters.
Chapter 6. Case Study 2

The socio-cultural framework for this setting encompassed the belief that all students could achieve and would do so because of the collective good of the whole group. This philosophy meant that there was localised as well as whole group support for any individual. Not only did the school have high expectations but these expectations were backed by families and communities and the future expectations for the female learners.

In terms of values within Technology Education, H2 did not engage in the affective, cognitive or active environmental values beyond the corporate values that were embedded in the school and its motto. The practice would not appear to be consistent with what was observed or promoted in the Technology department teaching and content but was consistent with conclusions drawn by Pavlova (2009b). H2 would not be drawn further on values past those which were embodied in the school ethos and its enactment. These were evident in the running of the department and the classes visited. The key value embodied in the school motto was that which appeared to embody what he and his staff aimed to achieve.

H2 was supportive of the research but had a firm view on the focus of his department and its industry relevance. He saw the junior school with good numbers of girls coming through due to the ASPIRE program and felt that the four female teaching staff did make a difference especially in the junior school to the numbers of females and their participation.

6.5 Case Study 2 – 2 Female Students - S2, S3.

The first meeting with the two female Year 11 students was conducted outside the classroom in April 2013.

The results and analysis for Student Two (S2) will be presented followed by Student Three (S3) using the same thematic headings used in all sections of the analysis chapters.

6.5.1 Student S2

S2 had been enrolled in the subject area before and was also studying Maths B and Physics. Her sister was currently studying engineering at University of Queensland and supportive of her learning in Technology Education and Engineering Studies.
6.5.2 Learning Ecology

6.5.2.1 Results

The class was located in a design workshop with tall tables. Machines had been brought into the room that would be needed in order to complete the construction project that was underway. There was storage at the back for the artefacts being constructed by the students. The class consisted of 23 students clustered around four benches which created a crowded workspace, given the other items in the room. S2 regarded the room as crowded but it did not stop her working. S2 stated that she preferred to work in a group rather than alone.

The class pedagogy was one of shared learning, shared knowledge in a mature classroom environment of self-directed learning. If students did not know the answers to questions about their construction they would return to their work stations, check their calculations and speculate on what the final outcome would be.

There were a variety of low risk tools in the room which was well resourced for the tasks at hand. There was a trusting atmosphere in that the students would develop the construction according to the plans they had developed. Students were able to raise issues with each other and the teacher and they talked through possible solutions. One debate was about giving more thought to angles. This was not only the girls but also applied to the boy’s inexperience with this type of problem solving engineering activity. With some encouragement the female students did utilise the machines. Figure 6.2 shows S3 using the machine. When they were unsure they checked with peers thus strengthening the peer support strategies that the students were encouraged to utilise in this setting.

The students were learning a complex engineering task by putting theory into practice through problem solving techniques. The female students were initially cautious about utilising the resources but gained in self-confidence over time.

Some of the male students were coming to the realisation after three months into the teaching unit that they had over done their designed solution, over engineered the design. The females were cautious to check their computer designs onto the paper plans and their test results
and did not work to extremes but rather honed their angles slowly and checked the progress of their work constantly.

6.5.2.2 Analysis

Toft (2007) argues while great strides have been made with regard to gender in the Design and Technology curriculum since the 1980s that gender and topic divisions remain. The staff in this study worked to create authentic and safe learning environments to enable the female students to complete their Technology tasks. S2 acknowledged that it was a crowded working environment however she indicated that this would not impede her personal development. This is consistent with Murphy’s (2007) findings that female students will adapt and engage in new activities with a degree of flexibility as long as they are engaged and valued.

Pintrich and Schunk’s (2002) findings on student engagement endorses the analysis of S2 who appeared to enjoy learning through the self-directed approach she was observed to engage in. She appeared confident and capable and able to self-manage her project and assist others around her with advice.

The low risk, trusting atmosphere as described by Siemens (2006) supports the notion that once the learners were comfortable in the environment they would engage in positive learning activities using the available technologies and resources. Pintrich and Schunk (2002) argue peer support strategies are used when learners are unsure. In this case the females willingly checked with peers thus strengthening the encouragement they received in this setting.

The environment, the setting and the resources catered to the immediate needs of students in order of appropriateness for them to complete the task. The results show that while the females were initially hesitant to engage with the machinery the relative simplicity of the task and supportive environment as outlined by Siemens (2006) encouraged them to engage. The finding that the female students were more willing to use the machines ahead of some of the male students appeared to be because of their confidence in the processes that they had planned and their organisational skills demonstrated in the process steps that they developed. They could follow the processes outlined in order to realise the artefact.

Pintrich and Schunk (2002) demonstrated that where motivation and academic achievement was found to be high it was a result of socioeconomic status, home involvement and parental support resulting in students aiming for higher outcomes. Male students overworked the task. The design and construction is interpreted in terms of how the male students approached the task as compared to the female learners. This is consistent with Murphy’s (2007) research where gender differences were reinforced by the teaching and learning. Students develop meaning according to Murphy (2007) based on the collection of their own experiences. The way in which S2 participated in the learning environment was consistent with the research which says that the socio-cultural reinforcement she was receiving was
important for her engagement in the Technology class. Her distinctly female approach to the task appeared to ensure that she confidently completed the task on track and on time.

In terms of the learning ecology, S2 understood the process and was confident in following her design and her process steps which led to the realisation and testing of her artefact.

6.5.3 Gender and Technology Education

6.5.3.1 Results

In terms of the classroom environment S2 responded that she enjoyed the class and the other students. While she preferred to learn individually she liked having mixed groups across all her subject areas. She indicated:

When I first started engineering studies I was scared that it was going to be all boys. Now I find it fun and I really like it (S2).

S2 did not believe her learning would alter if she had a female as opposed to a male teacher. She was unsure in her reply but felt nothing would be too different. She indicated: I have had female teachers in the past and they still knew how to use machines and do stuff (S2).

This student reported that she had an elder sister ‘doing engineering’. Gender stereotypes appeared to not be a barrier to what she wished to achieve in the class. Her quiet confidence indicated ability and yet she did not overtly demonstrate her apparent ability to her peer group.

S2 was one of the first to drill her piece of base timber. S2 did not hesitate to use the sander to make her angles however she did forget the safety equipment and was reminded by the boys. The female students saw putting the construction into practice as more of an issue than the boys due to their unfamiliarity with the machines. While S2 had studied in the department she had not worked with machines in the junior school. The lack of gender competition was noticeable. There was pervasive atmosphere of respect for all and this appeared to be the result of the consistent beliefs that had been expressed by the HOD (H2) and the teachers (T2 and T3) within the classes and reported earlier.

6.5.3.2 Analysis

Petrina’s (2007) argument that feminists want to change the status quo by increasing enrolments would provide a positive outcome in terms of increased female participation but would not, of itself, change the culture of Technology Studies. Petrina argues that the equality advocates want the ‘inside out’ change that may make a difference. Change the courses, the activities, facilities and content. Change the policies, perceptions, and personnel. “Change the optics of Technology studies” (2007, p. 202). Petrina states that, “Educators in the past have tried the short term
equity initiatives and we have arrived at small numbers of female participants” (2007, p. 202). Petrina argues that educators must acknowledge the need for the socio-cultural change such as that in Case Study 2. The lack of gender competition in this environment highlights the purpose of this study to identify those features that promote the participation of female students rather than preserving the status quo. In this sense the study is concerned with identifying longer term interventions which will engage female participants.

Belenky et al. (1986) highlight the voices of women when they talk of constructed knowledge. Whilst S2 acknowledged the gender roles of the teachers in saying the female teachers can: do stuff, she saw a male teacher as no different to the possibilities offered by the female teachers in the department. S2 was able to act on her own voice and engage confidently in the class.

Marra, Rodgers, Shein and Bogue (2009) support the outcome that positive success factors would reinforce long term participation. S2’s actions of not hesitating to try working at the machines appeared to be moulded by her values and the supportive socio-cultural environment; her home, her sister, and the school environment she worked in afforded her. The positive outcomes she received supported her greater success.

Brunner and Bennett’s (1997) research is consistent with what appears to be the gendered nature of engagement of S2 with the Technology activities. According to Brunner and Bennett (1997), the female attitude toward Technology looks right through the machine to its social function. This applies to a computer as much as the saw or sander in the workshop. S2’s engagement with the processes that required use of the machines illustrated her ability level. She appeared to develop a confidence in using the machines that led to the positive outcomes S2 achieved.

6.5.3.3 Summary

In terms of gender and Technology Education S2 approached the tasks according to her own ability. Given her confidence she was able to complete the tasks in a time frame ahead of many of the male students. Her socio-cultural background encouraged these achievements.

6.5.4 Language use in classrooms

6.5.4.1 Results

The female students were located on the front bench of the room but dialogued with the boys located on theirs and other benches. It was a two way dialogue and discussions continued when the students were waiting in line to use the machines. Shared discussions were fostered and the learning was within the context of what the processes were leading to. Ultimately the goal was
the testing of the constructed artefact and the writing up and evaluation of the process for the assignment.

All of the students were articulate and, early in the unit, could verbalise their understanding of the content of the unit they were studying. These included forces, compression and tension to name but a few of the concepts they were analysing during the task. There was a lack of gendered language as it was a task-oriented project with specific terminology. T2 explained any new technical terms to the whole class. There appeared to be a fluent dialogue between both genders who co-located at the front bench of the classroom.

6.5.4.2 Analysis

Eckert and McConnell-Ginet (2003) write about what they term, “the speech community” (2003, p. 56). In such a community knowledge of the language or linguistic practice of an existing social unit shares the rules for that community of practice. Given that S2 had participated in Technology classes in earlier years of her schooling she appeared to have readily developed a language of practice for this educational setting. In turn this would appear to have boosted her confidence to engage.

S2’s ease of engagement was consistent with her understanding of the technical and applied language requirements of this setting (Eckert & McConnell-Ginet, 2003). These included solving problems as they came to hand around the artefact construction.

6.5.4.3 Summary

In terms of language use in the classroom, the use of specific technical terminology in the class appeared to take precedence over gendered language. It could be summarised that technical language favoured the male students who have interacted with Technology Education in the past compared to the female students. The ability the females showed was that they could problem solve and adjust to the language in context to achieve high level outcomes.

6.5.5 Motivation

6.5.5.1 Results

S2 reported that she had experience in design and Technology as she had studied in this area in the junior school. She was excited about the item she was working on and saw it as a challenge but said she was not confident at the commencement of the unit. While the item they were constructing was challenging she saw it as more time consuming than difficult. She liked the subject because half the time she was doing theory and the rest putting it into practice. Her overall nature was quiet but composed and her objective appeared to be to get the project as accurate and ‘as right’ as possible before it was tested. There appeared to be a high degree of
encouragement from the staff for all students but intrinsically for the female students. It was observed that the teaching techniques and strategies used in the classroom and the shared role modelling of the other female students assisted S2, especially at the commencement of the learning process early in the school year.

6.5.5.2 Analysis

This notion reinforces the findings of the other case studies and the interviews with T2 and T3 where the female students would work for accuracy and achievement rather than speed and completion. The female students were in the first group to test their model. Autoio (2013) argues that self-confidence and expectations for success give value to the motivation available to females in current Technology Education classes. Techniques used by the teachers and the shared role modelling of the other female students assisted S2, especially at the commencement of the learning process and later to realise the task. S2 was able to complete the learning challenge quicker than many of the other students in the class. Murphy (2007) argues that, “girls are facilitators giving lots of support to others in discussing strengths and weaknesses of designs….even when working on individual products ….they will often talk out loud their problems and potential solutions” (p. 249). Murphy argues that previous studies have shown the differential approach of teachers to addressing female student issues. This did not appear to occur in this case study.

6.5.5.3 Summary

In terms of motivation, the task seemed to appeal to S2’s problem solving ability in the design and construction processes that the class were engaged in. Intrinsically, the challenges in the task appealed to the problem solving abilities of the female students.

6.5.6 Role modelling and peer support

6.5.6.1 Results

Preference for working in a group was indicated at one stage but initially S2 had stated she liked to work individually. S2 and S3 supported one another and male students at the same bench provided advice and direction when asked. The atmosphere appeared to be about shared learning in a comfortable environment consistent with Wenger’s (2006) conclusions about communities of practice. The radio was played at times and students enjoyed the relaxed environment and saw it as a privilege to be in the class.

The audio recordings of the classroom activity revealed that the students were more familiar with one another towards the end of the unit. Given that students were more familiar with one another they chatted not just about the work but also at a social level interspersed with
the construction task. S3 had also overcome the notion of being new to the subject area and collectively, the two female students seemed to fit into the class.  

For S2, her role model was her sister already studying engineering. The Year 12 girls who joined with the Year 11 female students as part of the early morning classes also contributed to the learning of the Year 11’s. Discussions, such as how to best attach the wood to the brackets and how to help the glue to set, were part of the dialogue between the female students.  

S2 had participated in Technology Education before and appeared to be quietly confident in what she was doing. Initially S2 said she had a sister who was into ITD (Industrial Technology and Design) and building things. It was not until later she said she was studying Engineering.  

6.5.6.2 Analysis

It can be concluded that Year 11 is a transition year to learning in this new subject area called Technology Studies and Engineering. Pintrich and Shunk (2002) argue that there is a social effect of forming new classes, in a transition period of one’s life, making new social networks and establishing oneself in a new subject area. Peer support is an important aspect for all students but the female learners, given their minority numbers, appeared to be more aware of the new situation they were in. Both girls appeared to have found a place in the class via their own mutual support plus their peer network.  

The development of strong peer networks and gaining a respected place in the class showed in S2’s enthusiasm and risk taking as her construction progressed. Dakers, Dow and McNamee (2009) suggest that motivation can be raised through addressing Technology Education as a positive concept which they (females) come into contact with often. The frequency of contact meant they would develop skills and knowledge. Kolmos, Mejlgaard, Haase and Holgaard (2013) argue that frequency of exposure and role models can be the link between Technology and femininity. Wajcman (2004) would argue that this links back to the dominant masculine definition of Technology and notions of patriarchy.  

The role modelling effect was important for S2. Pintrich and Schunk (2002) conclude that modes of influence from parental and familial support impact on the cognitive, social and affective development of learners. These factors along with their pro-social behaviour and academic achievement assist female learners.  

The familial motivational reinforcement which S2 received from home added an important dimension to her engagement in the Technology class. It can be concluded that there was social support as well as role modelling along with female stereotyping. Dakers, Dow & McNamee (2009), Klapwij and Rommes (2009), and Kolmos, Mejlgaard, Haase and Holgaard (2013) all suggest that these factors are assistive dimensions for student achievement.
6.5.6.3 Summary

In terms of role modelling and peer support, the sharing of ideas and workshop space along with the support of others around S2 enabled her learning to progress. These factors enabled her to achieve in the construction phase of the learning activity.

6.5.7 Socio-cultural approach to learning

6.5.7.1 Results

S2 liked the subject not only because of the applied theory but also as she saw the class as more relaxed because the students were able to come into the workshop before and after school. The nature of the hands on work meant that flexible timing was better than being limited to class time:

*The teacher’s expectations are of a high standard of what will be done and despite there being a lot to get through they are really helpful (S2).*

S2 verbalised that she was not quite sure how her artefact would ‘shape up’. *It was great on paper but that was the scary/exciting thing,* was her comment. Once she began the task, she did not hesitate to cut her pieces of timber. She methodically worked on the steps. She did not rush her work and stopped to think through the process at times. At times she aided the boys:

*Come on I’ll show you, she said to Johnny as he hesitated (S2).*

S2 decided to test her model on the first testing day. S3 had already tried hers. Initially, S2 was indecisive about when to test. Some of her struts broke, but not the main frame of the artefact, until the pressure was increased later in the testing. She carried the whole structure back to her desk and reflected on where it had broken and what she had done.

As each model was placed onto the testing bench, the teacher would ask where they thought it may break or take the most pressure. In some cases, this question allowed the students time to look at the piece – think about their construction and speculate on what was about to occur. Photographing the pieces and the events allowed each student to see what took place and compare it to their prediction/thinking as well as having evidence to use in the assignment.

6.5.7.2 Analysis

The findings around learning styles are important and show strong support for approaches to female pedagogy as argued by Belenky et al. (1986) and Eckert and McConnell-Ginet (2003). The female students related to what they termed the ‘relaxed learning style’ of the teaching staff. In essence it was far from relaxed. It was rigorous and structured in order to achieve the best academic results both for the students and the school. It is argued in this thesis that the instruction was performed with such confidence that it seemed relaxed.
“Gender is a collaborative affair that connects the individual to the social order” (Eckert & McConnell-Ginet, 2003, p. 31). It can be interpreted that, as S2 saw that she was learning at her own pace, she, in turn, exhibited a confidence and self-assurance over what she was doing. In turn she was then able to bolster and mentor others in the room. The analysis supports the fact that S2 felt she had time to make her own decisions and then reflect on her artefact. She was in control of her learning. Belenky et al. (1986) and Eckert and McConnell-Ginet (2003) argue that the emotional control as much as the physical empowerment enabled her to be successful.

Johnson (2002) saw the teacher as the scaffolder following the Vygotskian (John-Steiner & Holbrook, 1996) notion of learning as a process via interactions. It is important to note that the female student saw the teacher’s role as one that was relevant to her engagement and enjoyment of the class. The teachers’ checking for outcomes that promoted the pedagogy of social constructivism in an open ended interplay of knowledge and social experience made for learning that was meaningful for the individual students. It can be interpreted that S2’s preference for working in group is symptomatic of the socio-cultural traits illustrated by Belenky et al. (1986) and Lave and Wenger’s (1991) shared learning beliefs. Females tend to develop as individuals when working as members of a community of practice.

Colvin, Lyden, and León de la Barra (2013) argue that women are attracted to careers that help and work with people and enact communal goals. If females are provided with more knowledge of how careers in the STEM fields could be a vehicle to enact altruistic goals and values, they could be prepared to go along the STEM pathway. Social values are ranked highly by female students. Research in secondary schools in Queensland has shown that values can and do motivate students in Technology Education classes. Internal and external values as noted by Pavlova and Turner (2007) come into play at different points of learning for students. Instrumental values meant more for students starting in Technology Education classes. Learning for fun or for life skills was important to begin with. As students mature over time the terminal values of life and career goals came into play and the purpose for participating in Technology Education changed. Driven by internal values students were self-motivated to achieve in order to reach their end goal.

6.5.7.3 Summary

In terms of the socio-cultural framework for learning the program was carefully structured and enabled the female participants to find a place in the learning environment. Whilst the socio cultural setting did not afford the female students a voice the learning environment did provide space and facilitated their learning.
6.5.8 Values within Technology Education

6.5.8.1 Results

When S2 was interviewed and asked about what she saw as values that related to Technology Studies the reply was that she had done architecture through the Built Environment and Engineering (BEE) subject in Year 9 and 10. There was a marked lack of understanding about any values, personal values or social and environmental values.

6.5.8.2 Analysis

Pavlova (2009a) argues that empowerment is the embodiment of sustainability in the study of Technology and is hence fundamental to female students’ engagement. This was not the case with this student. Given that S2 had participated in Technology Education in her earlier schooling one would have expected some uptake of the concept of values as expressed by Pavlova (2009a) and Custer (2007).

6.5.8.3 Summary

In terms of values within Technology Education the students held little understanding of the term though they did uphold career orientations and short term goals in order to achieve their short and longer term learning needs.

6.5.9 Summary Student 2

S2 recognised and adapted to a teaching style that suited her as a female student. The format was scaffolded, documented and easily followed. It is argued in this thesis that there is a need to unseat the status quo of equity for all which is a default to discounting the female perspectives and subjectivities (Zuga, 1999). This is particularly relevant in Technology Education given its historic origins and unique separation between tasks for males and those for females (Zuga, 1989). In terms of social construction and the decade in which we now find ourselves, there needs to be a critical view of the Western androcentric view of not only prioritising male gender but of the dualistic view of sex and gender as outlined by Paechter (1998).

In terms of the learning ecology, S2 understood the Technology learning process and was confident in her steps which led to the realisation and testing of her design. S2 approached the Technology tasks according to her own ability and confidence and was able to complete the tasks in a time frame ahead of many of the male students.

Language use in the classroom through the use of specific technical terminology appeared to favour the male students who have interacted with Technology Education in the past to the detriment of the female students. The ability of the female students showed that they could adjust to the learning and engage to achieve the construction of the artefacts.
The motivation techniques used by the teachers and the shared role modelling of the other female students assisted S2 especially at the commencement of the learning process to engage in her own self-directed learning. There was a high degree of encouragement for all, but intrinsically for the female students. The structure of the course appealed to the problem solving ability of the female students.

Role modelling and peer support, the sharing of ideas and workshop space and the support of others around S2 enabled her learning to progress further than she anticipated when she began the course.

The socio-cultural framework for learning in the classroom was clearly structured and enabled the female participants to find a place in the learning environment. Whilst the socio cultural setting did not afford the female students a strong voice, the learning environment did facilitate their learning.

In terms of values within Technology Education, the students held little understanding of the term or the implications for personal goals or sustainability. The students did uphold career orientations and short term goals in order to achieve their short term learning needs. Motivation mixed with the unspoken values led to the high achieving outcomes of the female participants in this case study.

6.6 Case Study 2 - Student 3

Like S2, S3 had participated in BEE in previous years prior to commencing the technology/engineering class in 2013. She indicated that her decision to take the class was based on precision working. When asked about artefacts they had developed to date she indicated they had only done theory work.

The group would wait outside the workroom in preparation for the teacher to arrive. This was a good opportunity to see some of the informal interactions of the group and establish what the female students were going to work on before they entered the workshop. This time also allowed the researcher to catch up on what work had been done in between visits.
6.6.1 Learning Ecology

6.6.1.1 Results

The class was located in a design workshop with tall tables. Machines had been brought into the room that would be needed in order to complete the construction project that was underway. There was storage at the back for the artefacts being constructed by the students. The class consisted of twenty-three students clustered around four benches which were crowded given the other items in the room.

The learning environment was informal and flexible. Students could move to work in other spaces but most stayed and worked at the same location each lesson. The same boys located with the two female students (S2 and S3) at the front bench (Figure 6.3). There was a variety of tools and resources available for all students and the better organised tended to find the resources and share them amongst the table. This occurred on the bench where the female students were working. The pattern of most lessons was that the teacher would provide some direction to the whole group and then a demonstration if it was necessary then the students would turn to their individual artefacts.

Each student had designed three possible solutions as to how they would construct their artefact. The female students would often check their plans, record results and move forward with their construction work. Watching the students struggle with their designs early in the unit was difficult. Each student kept their selected formulated plan in front of them on the desks or
on their computers and used them as reference points. The two females initially struggled but some of the other male students took longer to realise their design than did the two females.

As the unit developed over the series of lessons, there was more informal dialogue on the bench where the females worked. Some interactions were due to familiarity of the students, dialogue flowed once the students were less conscious of the recorder device being present. A radio was turned on at times and the students appreciated this. The teacher would turn it off if he wished to address the class or demonstrate a concept on the overhead screen ready for the next phase of the project.

Testing day arrived and the female students were very confident they had completed their work. They were more confident than many of the male students who arrived still wanting to put cardboard re-enforcing onto their gantry constructions. Weights had to be filled out on the computer which projected onto the screen for all to view. S3 decided that she would test her gantry early in the lesson. Two of the uprights pulled out early and the teacher sent her back to re-glue these so her testing would have more validity. S3 took her structure back to testing just prior to the end of the lesson.

6.6.1.2 Analysis

It can be concluded that the flexibility of the learning environment appealed to the female learners. In terms of the learning ecology promoted by Brown (2000), learning in the room was connected in terms of structured learning. Each step was part of a well-planned unit. The students did not necessarily know where they were headed on their projects but the scaffolding of the teacher ensured that they had a design to work from.

Wajcman (2004) concludes that while the essentialist view of Technology remains one of gendered power relationships. It can be argued that the learning environment of this study has provided positive avenues to reach alternative solutions to solving the design problems which confronted all the learners. Teachers did not supply the answers but asked the probing questions to have students search for solutions. This can only be done by experienced teachers. Wajcman (2004) argues that while there remain hierarchical divisions between men and women as evidenced by the power relationship in the student and teacher relationship it is the techno-feminist theory which has enabled these students to free themselves from the social constraints that they could be burdened with.

In arriving at possible solutions for their work Murphy (2007) distinguishes between what girls as against boys pay attention to. Murphy states that, “Girls will consider the social context (the social world) and the aesthetics while boys will focus on the physical aspect and mechanisms” (pp. 246-247). Whilst the mechanism in the case study was dictated by the assignment, the perception of relevance and the presentation and appearance of the female students work was consistent with the findings of Murphy.
The supportive dialogue as argued by Eckert and McConnell-Ginet (2003) positions sexuality and language in the context of the environment where it occurs. Supportive and positive dialogue was evidenced in this setting with regard to the respect afforded the role models within the Technology department, student to teacher, teacher to student.

The finding that risk taking in relation to the designing and the testing of the artefact is an activity that the female students were more willing to engage in ahead of some of the male students is interpreted in terms of the Dewey model of learning through experience (Petrina, 2007). The ability of the female learners to structure their learning within boundaries and achieve a result through a technological process ahead of the male learners demonstrates the transformative ability of the learning process. The female students had progressed their learning further and in quicker time than had the male students.

6.6.1.3 Summary

In terms of the learning ecology, it can be concluded that the flexibility and supportive learning environment was conducive to catering to a pedagogy that is female friendly through support.

6.6.2 Gender and Technology Education

6.6.2.1 Results

S3 did not look confident in what she had planned to do when the researcher first visited the class. Johnny, a male student at the female’s workbench gave advice as the female students asked for it. S3 was more worried that she ‘hadn’t used the equipment before’, rather than about the design and construction task. Her planning was meticulous and she had her calculations and drawings backed up on her computer and checked these to ensure the stages she was to work through.

S3’s demeanour was very applied and studious, and various boys came to her asking for advice right from the early classes that were observed. She stated she liked to work in groups for projects but individually for theory lessons.

In terms of the teacher and gender, S3 liked having a male teacher and his method of teaching.

*He teaches the theory clearly then let’s us practice concepts for ourselves and is easy to approach if needed. It may be different if we had a female teacher (S3).*

In interviewing the two female students what they had gained from having the Year 12 female students in the workshop in the morning sessions, both students saw the interactions as positive for their learning.

Male students whom the researcher spoke to in this class said they liked to work with: *a mixture of girls and boys* (male students).
6.6.2.2 Analysis

It can be concluded that S3 took a ‘female’ approach to what she did in this learning context according to the thesis of Wajcman (2004). It is not to say that S3 has become the cyborg of Haraway’s feminist revolution but rather an outcome of the more liberal feminism of Wajcman’s postmodernist narrative (2004). She appeared at times unsure of what to do next but she returned to her planning and followed each step cautiously and accurately through her own agency and achieved a positive outcome.

Petrina (2007) suggests that there are curriculum designs suited to female pedagogy shaped through context and applicability of tasks. Like the two female students interviewed the boys spoke of their enjoyment of the Sciences and Maths along with this Technology class.

None of the male students interviewed (in the classroom) saw any difference in having a female teacher versus a male. To them knowing how the teacher ‘teaches’ was important. It can be concluded that the preference of students around teacher gender was to revert to the male teacher preference as per other participants in the research sites. Socialisation would appear as the key determining factor despite the role models in the immediate learning environment of S3. Spender (1980) would suggest that it could simply be a power factor determining the preference and the presence of males who are seen as superiors.

The teacher (T2) thought that S3 and S2 may have picked up a few ‘tricks’, such as hand skills that could help in their artefact production through having the older female students working in the same classroom space. S3 and S2 shrugged. S3 was reminded about the joining materials conversation with one of the Year 12 female students and yes she recalled the student showing her how to use the pins to hold the balsa and glue. The agreement and recognition that the older females interactions were positive reinforce what Eckert and McConnell-Ginet (2003) argue is the politeness and collaborative orientation that females enact through speech and actions in a working situation. This notion is linked to language use and speech-acts discussed below.

6.6.2.3 Summary

In terms of gender and Technology Education, despite the progressive element of female students and female teachers, there remains a traditional view of stereotypical participation within the educational setting. The belief of the female student was around improving one’s self rather than breaking any new ground for any feminist agency or as a role model to younger students reinforces the social model of old.
6.6.3 Language use in classrooms

6.6.3.1 Results

The working environment was very busy and at times it was difficult to set up the microphone and hope to hear any dialogue from the female students. Once the students were used to the recorder running, they forgot it was present and more working dialogue emerged. The type and complexity of technological language the students used expanded as they matured with the construction task.

These students were more confident to raise issues and talk through some of their solutions with more thought to angles as they progressed in the making phase of the teaching unit. This dialogue was not confined to the females; it was also male to male and male to female students. Peers were equals.

6.6.3.2 Analysis

The results show that language in this context differed little from males to females. Talbot (2010) argues that individuals are active in their own construction of gender identities. They perform their gender identities and these “Identities are shaped by discourse and help locate individuals within conversations” (p. 125). This supports the notion that S3 matured in terms of her subject position within the class over the course of the study. By the testing phase S3 could easily articulate and evaluate what she had produced.

Research by Eckert and McConnell-Ginet (2003) shows that as the students become more confident within a socio-cultural environment their discourse altered to be more technical and applied to the artefact development. Eckert and McConnell-Ginet (2003) note the female crisis of confidence in white middle-class teenage girls who subjugate themselves to a discourse of female subordination and material dependence on men when, at a time in their social development, they see themselves developmentally as part of the heterosexual market. Eckert and McConnell differentiate between the middle-class European girls and African American girls and developmental points where they will become assertive as opposed to deferential, quiet and tentative, nice girls within the learning ecology (2003). No distinction on race was made in the Australian case studies however the differing behaviours outlined by Eckert and McConnell could be seen in the female students.

6.6.3.3 Summary

The female students actively engaged in language specifics in the Technology classroom. S3 became familiar with specific terms through the discourses conducted at the working benches. It was the familiarity with language which provided her agency. In finding a gender identity
within the peer group the female students engaged in social banter which re-established the working group when the group reformed each lesson.

### 6.6.4 Motivation

#### 6.6.4.1 Results

While the learning appeared to be informal and flexible for students the teacher conducted a highly structured phased learning sequence. In allowing the students to struggle they dedicated more time to the workshop and to overcoming their personal challenges. As the girls gained an assured place in the workshop they were happier to talk with the researcher and answer questions as they worked.

The ethos of the department and the school permeated through the students work. Often the teacher would say: *We want you all to have VHA 10’s* (T2). The students saw the belief that they could achieve the highest academic score possible as encouragement for all with no particular bias to any student. All students were provided with sample assignment parts of the overhead (e.g., the executive summary) but told that their work was to be of a higher standard than the sample. The benchmark of standards and expectations drove all the students to improve their work. S3 did compare her work with the sample to ensure she would be above the level the teacher provided.

One interview was conducted while the students worked at the table in the workshop. These students felt that some motivation was derived from being able to talk and that this made the class: *more fun and mature while still learning*. One boy stated: *the teacher teaches and if you don’t do the work, you’re screwed* (male student). All the students, both male and female, were motivated to achieve high grades due to the nature of the school.

#### 6.6.4.2 Summary

Motivation to achieve in this site appeared as a collective goal. The female students knew that they had to work hard to reach the standards as prescribed by the teacher. As they gained confidence in their work and skills, they also gained self-efficacy in their own levels of achievement and in turn could consult with others.

#### 6.6.4.3 Analysis

There was a structured learning program put into place by a highly skilled teacher. The motivation and drive to succeed came from the freedom to learn and success along with high expectations without the students’ realisation. The learning ecology in this community of practice that set out to have students excel was highly effective in terms of catering to individual differences. This is consistent with the discussion of Nicholl and McLellan (2009) who argue
that motivation can be explained because, “we have an innate propensity towards active engagement with our environment and there is a need for the existence of three underlying core psychological needs: competence, autonomy, and relatedness” (2009, p. 229). An environment which satisfies these core needs will encourage well-being and growth such as was evidenced in this case study.

Nicholl and McLellan argue that if students have a sense of belonging in the classroom context and feel they get support when they need it then their motivational needs are met. The Technology department and the school were results driven. The medium was the individual and the desire of the students was to complete the best possible work that would reflect well on the school.

Where students felt a lack of autonomy, were not challenged and not supported, Nicholl and McLellan (2009) claim they were more likely to be de-motivated. At times it is not the reality of what occurs in classrooms but the perception of these that are the issue. Their research found that there is a link between the types of tasks students do and their motivation. The finding of the students working at the bench with the female participants is consistent with this research. Worthwhile projects built around a purpose contained intrinsic reasons for student motivation and in turn achievement.

6.6.4.4 Summary

In terms of motivation for learning within the classroom environment the female students enjoyed the apparent freedom to learn while achieving successful outcomes with their planning and realisation of their artefacts. The motivating factors were established through a well-structured program which engaged and challenged students.

6.6.5 Role modelling and peer support

6.6.5.1 Results

Johnny (male student), who co-located at the workbench with the two female students, gave advice on the construction methods as the girls asked. He did not lead but provided information when asked. While S3 began the practical work, with less confidence, she felt supported through the group and became more self-assured.

Despite having a lot to do for the construction, the write up of the project, the photos and the research for the assignment S3 continued to see the task as fun. Flexibility makes this fun.

In interviewing the two students (S2 and S3) as to what they had gained from having the Year 12 female students in the workshop in the morning sessions, they were asked had they picked up a few ‘tricks’, or ‘hand skills’ that could help in their work. The females shrugged.
When S3 was reminded about the joining materials conversation, yes she recalled the student showing her how to use the pins to hold the balsa and glue and the activity that flowed from it. It was however not attributed to anyone in particular.

A social and peer network developed amongst the group of students at the bench. They were new to the course at the start of the teaching unit and a newly formed friendship and working group. Trust and technical expertise developed in the class but the immediate group at the bench were the most relevant group, as the constructions developed. The socio-cultural networks that were both formal and informal helped to build the learning community that framed the place for the female students to work and achieve their goals.

6.6.5.2 Analysis

Pintrich and Schunk (2002) in arguing the case of the characteristics of effective models of learning make the distinction between mastery and coping models. “Initially participants will demonstrate fears and deficiencies but gradually improve their performance and gain confidence” (p. 155). As the student artefacts formed by mid-term the students were more confident and pleased with the ideas they had been allowed to experiment with. S3 no longer feared the words: re-model, re-adjust your design. S3 and S2 were happier to stick with their calculations and move toward being ready to test their artefact as they had moved past the coping model toward peer models. Pintrich and Schunk’s research shows that students who engage in some form of observational modelling will out-perform those who had no modelling to reflect on.

The peer networks became the assurance that the female students relied on for testing ideas. The writings of Dakers and De Vries (2009) highlight the historic nature of the female identify as reliant on males and Technology then one could ask if the females in the study were reliant on the affirmations of other males in the peer group or the teacher as a male figure.

The study by Hong, Hwang, Wong and Yau (2011) concluded that there were few differences between the learning of males and females in Technology Education. This differs from the findings of Weber and Custer (2005) where the female students wished to engage in design oriented activities as compared to the male students whose preferences were for utilising learning experiences.

The caution from the research studies listed above is that teachers should not assume that boys or girls will naturally like certain things in the subject area. Dakers and De Vries (2009) argue that it is the human-technology perception which has implications for how students may, “perceive the techno-cultural world they occupy” (Dakers & Vries, 2009, p. 205). Role modelling is frequently seen as non- gender bias. When role modelling is overlaid with a feminist methodology this thesis argues as does Hesse-Biber (2010) that feminist objectivity is required in order to capture the subtleties and nuances of women’s experiences.
6.6.5.3 Summary

In terms of role modelling and peer support the analysis indicated differences in how the female students worked and learned from peers as against how male students worked and interacted in the classroom setting. Socio-cultural factors come into play in the learning context.

6.6.6 Socio-cultural approach to learning

6.6.6.1 Results

During the early visits to the class studying the gantry unit, the females did not seem to be making as much physical progress as the boys. On observing more closely, the girls were spending considerable time measuring their angles and trying to be accurate. S3 and S2 marked the wood carefully before cutting angles. The teacher checked what they were doing but did not change the process the students were working through.

Early on in the project the observer watched S3 struggle. She verbalised that she was unsure about how to put the uprights into the base. She asked a few people around her but not the teacher. Some students replied that they did not know. This included her female counterpart (S2). After a couple of suggestions, S3 laminated four pieces of balsa together. What she was making did not mirror her design but she assured the observer when asked, that it was her plan.

There was discussion with the teacher after the researcher watched both female students struggle that lesson. S2 was chiselling to get accurate angles. S3 was still unsure but worked on. The teacher was asked:

*How could they be sure the product would get off the ground, be realised (Researcher)?*

T2 took the researcher through the testing phase and explained:

*No if they were struggling to realise their plan and it was not working, oh, then they would need to redesign (T2).*

T2 watched what the students were doing but did not buy into a discussion with them about their work. The following week S3 still seemed lost in how to form her tower. S2 continued with issues of angles so both spent time testing and retrying following a design cycle process to get the structures to where they should be. Confidence in what S3 was doing developed during the course of the unit. It was new learning for all of the students but S3 was particularly careful to following the project steps in order to reach an outcome in the task.

6.6.6.2 Analysis

In terms of the female student’s socio-cultural approach to learning, Nicholl and McLellan (2009) argue that autonomy and appropriateness of task will shape a female student’s
competence in a learning environment. The type of attention afforded a task will vary according to the challenge and the choice provided. In addition a female student’s perception of the task may shape their approach to the activity.

Pintrich and Shunk’s (2002) research points to the intrinsic motivation engaging in the activity for its own sake and for its enjoyment as opposed to the external motivation of reaching an end reward. The application to task set the females aside from the other participants. The findings show that allowing the female learners to struggle within the project was a learning experience that would develop the students as learners in technology. S3 was still working through her uprights issues while S2 changed angles and would come back to the 45 as opposed to 38 degree angles during the next lesson. This is interpreted as a teaching experience that is not gender specific, however the persistence of the female students to diligently find the correct angles was in contrast to the approach of the male students. It is the self-modelling and coping strategies argued by Pintrich and Schunk (2002) and Nicholl and McLellan (2009) that not only led to higher self-efficacy and motivation but also skill acquisition in S3 and S2. The male students discarded poorly functioning pieces whereas the females persisted with the task reinforcing the findings of Pintrich and Schunk that teachers may need to “integrate statements and practices designed to raise student’s self-efficacy through their ways of working” (2002, p. 159).

Solving student’s challenges was not what T2 did. He put into practice the strategies of autonomy as argued by Nicholl and McLellan (2009) that once students have a set of ‘how to’ procedures by exploring the why and where of this knowledge they will use it to solve complex tasks. In this instance students will gain greater understanding of the task along with procedural cognitive processes enabling them to meet other design challenges.

The strong support afforded each female student highlighted the socio-cultural support that was part of this learning ecology. The academic achievement motivation that Pintrich and Schunk (2002) talk of supports these findings. S3 would return to her social reference group, discuss an issue and made the necessary adjustments to her artefact. In analysing the engagement of S3 her early lack of construction experience meant that her uprights due ‘came apart’ during the stress test. The uprights pulled out due to an absence of or too little glue and her failure to take on board the ideas of strapping and bracing for reinforcement that she gained during the role modelling of the Year 12 female. It can be summarised that more experience in using the materials for this applied purpose would enable further success via familiarity with the processes.
6.6.6.3 Summary

In terms of the socio-cultural frameworks around females in this learning environment there was a strong and well-structured supportive mechanism that aided the female students to enter the Technology workshop, learn and quickly become a working member of a working group.

6.6.7 Values within Technology Education

6.6.7.1 Results

The female students in Years 10, 11 and 12 all reflected on the ability and professionalism of all the staff but each saw the female teachers as unique and with great ideas and ability. S3 believed it was her responsibility to use machinery carefully and to be up to date with her work. The students did not see a resource value in the materials they were using or a use in keeping the artefact after the testing. Most students relegated their tested and broken models to the bin after the stress test. The two females kept theirs – one took it home to show her family.

The way in which S3 adapted her design and undertook some unplanned experimentation is fundamental to Technology Education. The female students did rely more heavily on their pre-planning and returned and referred to their designs more often than the male students. Like the other students, S3 did not have a notion of values other than an ambition to achieve in the STEM subjects because she did well with them. S3 had her own type of intrinsic motivation but did not express a long term goal related toward working with Technology.

6.6.7.2 Analysis

According to Pintrick and Shrunk (2002), S3 did have two interchangeable notions of values and motivation occurring during the production of her artefact. Intrinsically she enjoyed engaging with the task but the greater motivational factor was the extrinsic force of achieving an academic result at the end. Her values were not in terms of the sustainability of the resources that were being consumed (Pavlova & Turner, 2007) but rather in the use of the learning to achieve a long term career goal.

The value of the materials appeared to be of no consequence to S3. She was not wasteful with materials but did not afford them any value when experimenting within the design. S3 relied on female ways of working in terms of what Belenky et al. (1986) argue are female approaches to learning that involves discussing what is to be done, thinking processes, checking ones planning and then undertaking the task.
6.6.7.3 **Summary**

In terms of values within Technology Education, there was not clear articulation of values related to materials or the short term meaningfulness of the project itself. S3 held career goals but did not see these as values.

6.6.8 **Summary of S3**

In terms of the learning ecology, it can be concluded that the flexibility and supportive learning environment is conducive to catering to a pedagogy that is female friendly. Despite the progressive notions of the school department toward female students and female teachers, there remained a traditional view of stereotypical participation within the educational setting in terms of gender and Technology Education. The belief of S3 was that she would better herself rather than breaking any new ground for any feminist agency or as a role model to younger students.

In terms of language in the classroom, the female students actively engaged in becoming familiar with specific terms through the discourses conducted at the working benches. Their gender identity was clear within the peer group they engaged in. The social banter at the table and the responses to questions the females had around the work at hand indicated their willingness to learn through dialogue.

The motivation for learning within the classroom environment encouraged S3 who enjoyed the apparent freedom to learn while achieving successful outcomes with her planning and realisation of the artefact. The analysis has shown that in terms of role modelling and peer support there are differences indicated in how the female students worked and learned from peers as against how male students worked and interacted in the classroom setting.

In terms of the socio-cultural frameworks around females in this learning environment, there was a strong and well-structured supportive mechanism that aided the female students such as S3 to enter the Technology workshop. S3 learned and quickly became a working member of the group.

The analysis has shown that, in terms of values within Technology Education, there was no clear articulation of the concept related to materials or the short term meaningfulness of the project itself. Hence, the individual could not articulate the concept.
6.6.8.1 Emerging findings

A number of common findings emerged from the participants within the Case Study 2.

Firstly, the notion of belonging to a community of practice was a key motivational factor for the female participants. Whilst the notion applied to both males and females, it was the female essence of belonging and identification with the group (socially) which made a difference.

Secondly, speech communities, as expanded by Eckert and McConnell-Ginet (2003) meant that a common language and understanding afforded the female students a voice within the learning environment. Once the female students understood and could use the terminology and genre of the subject their participation and outcomes increased.

Thirdly, motivation from family and peer supporters, with academic expectations of themselves, was a feature of the female student’s engagement. The school and community appeared to make a difference in a social context along with the acceptance of the female participants. Peer support was not limited to one gender but was an important factor in terms of female staff and older students seeing and respecting the females who were present in the workshops as role models.

Finally, the curricula programs assisted female students to set goals for themselves and achieve them. This was a factor in their participation and achievement in the Technology Education class. Artefacts need to be meaningful to individual learners as does the curriculum approach.

6.7 Conclusion

A teacher’s awareness of ecologies which aim to encourage female students will assist curriculum planners and administrators to examine current practice and learning environments and engage more females in Technology Education classes. Case Study 2 has demonstrated four factors which facilitate female student participation in Technology Education. Key to this is motivation within a supportive learning environment fashioned on high expectations. The following chapter presents Case Study 3, which is the final case study.
Chapter 7

Trades and Technology

This chapter presents Case Study 3, which is the third of the three case studies. Chapter Five presented Case Study 1, a case study from the Technology studies area which focussed on technique, Chapter Six presented Case Study 2, an academic approach to Technology and engineering, and Chapter Seven presents Case Study 3, which looks at Technology studies from a trades and vocational perspective.

The analysis chapters present the results and analysis of the observation of a unit of work in a senior secondary school setting in the area of Technology Education. The chapter presents the third case study of two female participants in a suburban secondary school in Queensland. The chapter has been analysed in themes according to those which emerged from the literature review and from the case studies. The data have been triangulated according to the research methodology. Data collection methodology was replicated in every site. The researcher was a participant observer. Data collection tools include interviews with students, interviews with the teacher and the HOD, transcripts of audio recordings of students participating in the workshops and during interviews as well as photographs were used in the analysis.

The research study has examined three senior secondary high schools in South-east Queensland. The researcher took on the role of participant observer visiting the schools and classes over a 14 week period. This involved visiting classes regularly and following the units of work with the classes and their teachers.

The ethnographic case study approach enabled the researcher, as participant observer to work beside and with the female students. Observations were made as to how the female students interacted and worked with each other, with the rest of the class as well as the teacher and other staff members who were present. There were no restrictions on photographing the students or recording their voices or the researcher moving about the workshops and talking to staff and students. The environments the students were working in for Case Study 3 replicated a workplace and students were expected to meet workplace standards of dress and function in applying themselves to the tasks being undertaken.

Data for this, as for the other case studies, will be analysed through four data sets. These include interviews, observation data, audio recordings and photographs taken by the researcher or the teacher. The interviews include conversations with students, the teachers in each of the case studies and the HOD. Reflections by the researcher were made after each of the visits. Data were collected by the researcher in a journal and via class observation sheet. Campoy (2005) writes on the development of reflection within case studies in order to grow and to improve on the experiences through the analysis.
7.1 Description of the themes

A brief description of each of the themes was outlined at the commencement of Chapter 5. The analysis has been done according to each theme.

7.2 Collection and Analysis of the data

Each analysis chapter is divided into four parts, the teacher, the HOD, included in this area are Deputy Principals and Principals, and students with a concluding summary. Chapter 4 provided a detailed outline of the methodology used in the analysis.

7.3 Case Study 3 – The school

The school, according to the public website;

*Seeks to develop successful citizens by helping each student to identify their affinities and passions. We encourage their transition to adulthood by developing their knowledge and values, enabling them to make wise and just choices, creating a better future for all.*

The mission and values the school has adopted Gardner's (2006) *Five Minds for the Future* as the basis for its curriculum framework. Society's future leaders need to be able to develop certain ways of thinking and working which allow them to bring the best to any situation. Gardner describes these five minds as:

- The Disciplined Mind
- The Synthesising Mind
- The Creative Mind
- The Respectful Mind
- The Ethical Mind

7.3.1 The Principal

Initial discussions with the principal examined the aim of the Technology class from the previous year when it was run as an all-girls, ‘Girls in Construction’ class. The Principal explained that the class was run under the Women in Hard Hats program and students took it as a seventh subject. The seventh line was run in the school for high end courses and it enabled six lines of normal subjects and spares such as access and another four periods to be utilised to run the class. It was led by a female industrial arts teacher who had since become the HOD at one of the newest secondary schools in the south-east region of Queensland.

The principal believed that the class was so successful that all the participants had left the class for the right reasons. The reasons for leaving the class included securing work or to change to Engineering Technology in order to gain higher entry qualifications to tertiary
studies. Others had left because of job offers which were afforded them as a result of their potential skills recognised via the course. The principal firmly supported any research in order that the school stay up to date with what is happening on the educational landscape. The year of the research study he was anticipating the opening of the Trade Training centre and was keen to be part of future developments in Technology Education.

7.3.2 The Year 11 Technology Design and Construction class

In this site there were three girls in the Year 11 in Building and Construction class. The female students identified as of Aboriginal descent. One of the girls left the school not long after the study began. Two participants remained. The program provides an advantage for those seeking an apprenticeship. Trade outcomes include shop-fitting, joinery, signage, brick and block laying, carpentry, concreting, demolition, dogging, painting and decorating, segmental paving, rigging, roof tiling, solid plastering, wall and floor tiling and waterproofing.

The first visit to the school was to meet the staff to talk about the research and the environment and to look at suitable times to view the program to observe and interact with the female students and the class. This class was selected given that it had a number of girls in the course.

The first full day visit with the class was a bricklaying workshop with an outsourced provider who took the class through the skills suited for bricklaying. Subsequent visits saw the class designing and then building two walls to encase the bottom of a stairwell. The created space would be used by the school cleaners for storage.

7.4 Case Study 3 – Teacher 4 (T4)

On each of the visits, the researcher met with the teacher (T4) and H3 (HOD) in the staffroom. There would be a discussion as to what was to be undertaken that day. Normally, there was a debrief following the lesson, or during lunch times, if the lesson time was split by a break time. The teacher decided initially that he would fill the interview form out online and email it to the researcher. T4 did so, but decided toward the end of the study that it would be easier to talk through the topics as well. The researcher visited during the teacher’s preparation and correction time.

This teacher (T4) was middle aged, had been teaching for twelve years in Design and Technology, and had trade qualifications in carpentry. The school was regarded as being in a working class area and the focus of the department was to teach students skills for work readiness. The Design and Technology department was about to have a Trade Training Centre built and this aligned with the notion of teaching skills for work.

The following sections present the results and analysis from T3 in Case Study 3.
7.4.1 Learning ecology

7.4.1.1 Results

The physical environment where this class was held was an open area workshop, undercover on a concrete apron. The setting backed onto a series of classrooms. T4’s intention was that the area replicated student’s being in a workplace. The organisational system appeared less structured and appeared to work on the master and apprentice relationship. Students arrived to the allotted space, put their bags on shelves and were ready for the practical class to commence. The approach of the T4 appeared casual and his demeanour seemed to appeal to the students in the class. The relationship, students to the teacher, appeared to be respectful and positive.

The interview with T4 and H3 highlighted that the purpose of the construction group (this particular class) was to contribute to the school community. At times, the priority of the school, to have a bar-b-q or a path completed, would take over from finishing the scheduled learning task. The staff indicated that completing tasks for the school was not directly aimed at providing service but rather providing a product for a user. The Technology department aimed to make the tasks real life and not simulations.

*The students take on a sense of pride and ownership in what they contribute to the school via their own manual work (H3)*.

In terms of the learning environment and its ecology, the class was comprised of a diverse group of students. There was a cultural mix and some students were regarded as behaviour problems in regular school classes. There were no behaviour issues within this group in technology. The resources for the tasks which the group were to undertake were available and accessible to the students under the direction of the teacher.

The students, for the most part, appeared aware of the tasks they were undertaking, but not always when they would be doing them. They waited for direction from the teacher before proceeding to the next step of their construction tasks. The planning of the stairwell project was undertaken in a library annex teaching space in one lesson. The design phase of the stairwell project was a teacher centred activity with diagrams on the board and verbal input from the students.

T4’s response was;
*All ITD (Industrial Technology and Design) projects and experiences are designed to develop work readiness. Our focus is entirely on post school options and future options which can begin during school years such as school based apprenticeships and traineeships (T4)*.

T4 explained that he needed to lead and guide the planning of the wall; that’s because it’s hard for kids to crystallise that when they are going in so many different directions (T4).
7.4.1.2 Analysis

The debate which Dakers (2007) claims is worthy of some discussion is whether students who are perceived to under-attain follow a vocational curriculum guided by the needs of a national or local economy. For this Technology class, the staff aimed to replicate a work environment. The local economy appeared to be replicated in the school community. The students undertook certificate work which provided the members a vocational education path. Daker’s argument that those who are “less intellectually capable of following an academic curriculum” (p. 91) are perceived as suiting design and technology, appears to be what is occurring in this site. Daker’s acknowledgement that the views are embedded in a well-established cultural system which values academia over vocational qualification reinforces the beliefs of this subject being less valued as against other senior school subjects. The school timetabling relationship appeared to reinforce this ethos.

Blewitt (2006) explored social learning and community action activities and practices and learning experiences which help build sustainable communities. While the examples belong to the United Kingdom, the community development projects undertaken in Case Study 3 reflects the skills development Blewitt (2006) highlights. Skills, recycling and environmentalism all contribute to the partnership for sustainable community development. The staff and students reported being side tracked onto short term ‘school community’ projects. The results of contributing to the school community are evident on the site (Case Study 3) and this was supported by what the students, who were interviewed in this case study, said that they valued.

Blewitt (2006) argues that given the diversity of the group of students, the type of projects offered and the focus of the department that T4 was catering to ‘work ready the students’. T4 acknowledged that many of the students were drawn from working class families due to the location of the school. Resourcing for the projects in the department seemed to meet the needs of the tasks being undertaken.

Phases of the learning and the teaching style of T4 appeared to suit the students in this group. It was a secure and safe environment which enabled students to apply themselves to a task and work at it, with direction. Their waiting for teacher direction as a style of learning which demonstrated a trades specialisation was as Dakers (2007) argues instruction for specific knowledge. Dakers in following the notions of Dewey argues that this style “lacks general ideas, a general culture and style while providing a firm hand” (p. 99).

Developing work readiness was the focus of the staff in this case study. The conversation of T4 and H3 returned to the importance of the concept. Dakers (2007) argues if this is appropriate for students in areas of real disadvantage and in a culture of under-attainment. Dakers cites the UK government’s program and explains it as an age old debate (p. 102). There
should be no division over the ‘brains or brawn debate’ when Dakers expands on the differences between occupational versus vocational education. Daker’s argument promotes the notion that students cannot be critically aware of their learning if they are immersed in vocationalism that is narrowly focused on a trade specialisation. It is not the passing on of manual skills from one generation to the next through on the job training. It is as Dakers argues a school subject with both practical and academic parts. This thesis would question whether there were any real design and technology elements apart from learning and executing skills in Case Study 3. Dakers claims there can be no experimental or critical components when students are in a poor cousin to academia disguised as vocationalism.

7.4.1.3 Summary

The learning ecology in this case study encompassed many of the elements that this thesis has outlined in terms of being an effective and positive learning environment. It was a supportive surrounding, with peers who appeared to mix with one another, positive student teacher relations, resource rich venues with tools appropriate to the tasks at hand. What it lacked was a cohesive group dynamic and independent, individual motivation that saw students making key decisions about the projects that focussed on what has been termed ‘real Technology Education’.

7.4.2 Gender and Technology Education

7.4.2.1 Results

Three girls began the course. The two females who remained in the course tended to stay close together during the planning and construction phases of the unit. T4 saw it as important that there be some ‘back up’ for each of the females in the class.

During the interview with the teacher, the topic of process over product was discussed. T4 believed that the process is what they are teaching in terms of ‘getting students ready for employability’. The processes inside the Certificate 1 required observation sheets to be completed and oral questions so that the students could be marked on competency achievement.

*The females have better listening skills, hard work ethic and respect for self and others. That’s the key that the girls have the ability to be successful. At the level we are working at, Cert. I I don’t think prior knowledge helps. If they [the students] can listen well and apply what they hear then they will do as well as anyone’ said the teacher. The things we have talked about here are the things that often let the boys down and the things the girls do well at. If they can get over the social issues – appearance and maybe the feeling of intimidation then I think they would do a better job (T4).*

When asked about the differences between learning styles of female and male students in Technology Education T4 noted,
The females are more focussed on doing a ‘good job’, where the males are more focussed on doing a ‘big job’. For the boys, everything is a competition, speed or size etc., whereas the girls are looking for more quality (T4).

Now and again, you will get a female student who will come in and say that’s what I am going to do. We had a female a couple of years ago who was in that program. She just wanted to get a job in civil construction. She wanted to drive an excavator. She just loved it because she did some work experience in that area. Sometime maybe next year these females will get the chance to drive a simulator or a dump truck or a mini excavator. We do have an industry partner who will let us bring a bus load down. (T4)

7.4.2.2 Analysis

Rasinen, Ikonen and Rissanen (2006, p. 52) quote the Finnish 1970 Curriculum Framework which states that, “Girls and boys should not be separated during craft lessons. Projects should no longer be based on sex but rather divided into technical craft and textile craft and both sexes would study them through various ages of schooling”. Invariably the boys opted for the technical whereas the girls were more open to choices. The division did not continue but the US experience as noted by Haynie and Sanders (in Rasinen et.al. (2006) is that the subject has attracted more females since the abolition of the term ‘industrial arts’ and the teaching staff composition has changed from singularly ‘middle-aged white men’ (2006). This research illustrated that the myth of men’s jobs and women’s jobs has tended to continue to influence both curriculum choice and career choice. T4 viewed the female students as needing social support. The conclusion being that his view would extend to them [the female students] needing subject support because of their gender.

The Weber and Custer (2005) research argued that the points of difference between males and females saw females favour design while males had a preference for repairing products. T4 talked of the females doing a good job. The skills development of females was above the males in planning and visual appearance. The female preference was the aesthetic and organisation over the ‘doing and the physicality’ of the tasks. Murphy’s (2007) research has shown that “females were concerned with the social consequences of their designs” (2007, p. 239). Murphy’s ongoing research reinforces these findings (2009).

Gender difference as to how one group operated in a Technology Education workshop showed differences in learning. As T4 reiterated, boys do a big job, girl’s a good job (T4). Wajcman (1991) illustrates the past where the historic view of women is portrayed as end users and consumers of technology. The masculine preserve has historically been to own the technical space that has not been seen as a place for women. Wajcman (1991) correctly argued that the technical competence of females will be lacking and a pattern of unskilled work becomes the norm with respect to females because of their lack of engagement over time. Murphy (2006) addresses these issues with regard to the English curriculum and gender-Technology
interactions. In recognising the social constructions of the development of the subject and its roots in the apprenticeship model, workshop practices are hostile to academic theoretical knowledge and often seen as low in status (2006). Murphy’s earlier studies showed that boy’s designs showed little concern for social or environmental consequences but did detail mechanisms and structures. “Females look at needs and circumstances within their planning while males will experiment to do a task” (2006, p. 73).

Hoepfl (2007) argues that it is differentiation for individuals that should be the key to success in the Technology classroom. Analysing the dialogue of T4 is important. T4 recognised that females can focus in Technology Education and achieve in the subject. The apparent rarity and abnormality of females in senior Technology and the discussion being held with the researcher signified that Technology Education has not overcome its historic sexist cultural stereotypes. If ‘being female’ was not identified as the exception to the norm the female student would not have been noted as an ‘outstanding female student’. The dialogue should be one that addresses individuals and their achievements rather than ‘one female student’.

7.4.2.3 Summary

T4 acknowledged the differences between teaching and the engagement of males as against females in the skills area of Technology Education. T4 along with his colleagues did not perceive that their teaching practices needed to alter because of the class composition. T4 afforded the females time and support which in turn aided their confidence in engaging in the subject. T4 failed to analyse the long term social factors and social perceptions which were important to the female students. Instead T4 focussed on the objectives and outcomes of the course ahead of the individuals.

7.4.3 Language use in classrooms

7.4.3.1 Results

Language use as a term and a discourse did not come into the discussion with the teacher. T4 talked about listening skills that he saw as paramount, hard work ethic and respect for self and others. In observing the class over an extended period of time the language use was respectful and focussed on the tasks at hand. The only time gendered terms (e.g., guys) were used was in calling the group in to advance to the next step in the process. On one occasion the teacher said: *If you [the researcher] were not here the term of address would be something different* (T4).

7.4.3.2 Analysis

Default language to the male in accord with the early findings of Spender (1980) and Talbot (2010) reinforced that despite the advent of equal rights and opportunities and work place
legislation nothing has changed. The comment: *if you were not here then the term of address would be something different*, again implies that there were limits placed on what the researcher viewed as much as a default language use which was implied. Rothschild (1988), Eckert and McConnell-Ginet (2003), and Talbot (2010) similarly identified the masculinity of language use and questioned what has altered over the decades.

7.4.3.3 Summary

Language was focussed on tasks and the specific terminology required in order to undertake and to complete those tasks. It was not seen by the male staff members as anything that needed to be altered or that would be changed. This further crystallised the extent of masculinity of the prevailing culture in this case study.

7.4.4 Motivation

7.4.4.1 Results

In interviewing T4 about the qualities of a successful female student T4 spoke of his perception that the girls needed to have, *a greater self-respect in order to be more successful in ITD* (Industrial Technology and Design) [his use of words], *where more males exist* (T4). Both girls were of Murri dissent and yet this aspect of their cultural difference was not discussed nor viewed as a reason as to why they had chosen the Technology Education class. T4 indicated that the girls did not put themselves in front of the group however what they presented was consistently good quality and correct. He indicated they would not wish to stand out for criticism in front of the rest of the class.

7.4.4.2 Analysis

Murphy (2009) suggests that culture as well as gender should be a consideration when planning curriculum. In discussing the qualities of a successful female student T4 appeared to fail to understand what did motivate the two female students. It was their quiet confidence that provided their motivation to be present in the Technology Education class. It was the same motivation that enabled them to have a space (though not a voice) in this traditional male learning space. In reflecting on the comment that *the girls needed a greater self-respect*, this could be linked to the notion of the quiet confidence that could have been attributed to a cultural aspect of their being. Pintrich and Schunk (2002) argue that motivation stems from within but is manifest through external factors of achievement, valuing the activity and outcome oriented goals that help guide learners while in the care of Technology teachers.

As argued by Dakers (2007) there was a master apprentice relationship exhibited through respect afforded to the teacher (the holder of knowledge). Co-operative learning took
place once the routine was outlined to the students. In examining the elements of the learning environment, as argued by Brunner and Bennet (1997), it was too rich, had consistency and time, was a trusting environment of interactions with simple social approaches to ideas and what was to be achieved. Planning for learning and much of the learning in this setting did centre on and around the teacher. It was contrary to Brown’s (2000) assertions that directed learning from the centre would diminish and student centred learning would take over. Over the breadth of the visits to the school the students did become more confident and independent but did not direct their own daily activities. The female students had grown in confidence and were more willing to show their ability in piecing the wall frame together. There was a focus on learning and some tolerance for experimentation within budget and time limits. The outcome was the empowering of the individual female students. There was lee way for motivation however the students did not have an opportunity to exhibit individual leadership because of the master apprentice relationship that guided the learning.

7.4.4.3 Summary

The presence and motivation of the girls appeared to be attributed to their sense of worth rather than what teaching practices were used. Their own work contributed to their place in the class. While this study believes that there is a need to find a place for female participation it is practices which heighten motivation which are the enablers. The female students exercised a presence and wanted quality work and precision to be part of their achievements however they did not exercise a voice within the group.

7.4.5 Role Modelling and peer support

7.4.5.1 Results

T4’s first response to a question about successful classrooms for female students with respect to differences during the interview turned to the topic of what qualities female students would look for in a successful classroom.

I’m talking about the yes respectful; inclusive, safe. I saw all that in your response but is there any difference for the girls in having other girls or in having colours around them or butterflies on the wall…? (R1)

The teacher was looking less comfortable-

Ummm, the girls that I have worked with in these groups don’t seem to be as bothered about that. That’s my take but then having said that it may be more my observation than the reality. They may be more concerned than they let on…. Ahhh but, ahhh. Yeh no I don’t know that that’s a big issue for them. Can I just leave that question? (T4)

In examining what qualities what might attract girls to a Technology Education, the reply was,
Again I think it is the girls only factor - ... the issue we have is that competing with other subjects that are also important to them. Some of the girls are not doing it because… if you want to go back to your visual thing – are not doing it [Technology] probably because of the things we have to wear. It doesn’t appeal to a lot of girls to wear steel capped boots, to wear high vis. vests. A lot of the girls are interested in their appearance and at this age probably find it hard to separate that. At this school particularly, at the age, the girls here are very, very much about how they look.

They [the female students] need to overcome a few barriers to throw on the workman’s clothes. But also the all-girl’s class where there were no boys helped. I think you see that with this class and the two girls. Just their shyness. They’re quietly confident but will not leap forward. They will sort of slink forward and do something rather than push forward. And I think that because there are other boys there it doesn’t help. It makes a difference. Last year’s group were quite outgoing and at least confident in their own abilities, or at least not afraid to fail as these girls are (T4).

The school in 2012 had been proactive about promoting a ‘Girls in construction class’. The principal reported he was pleased with the outcome of this class and this was restated by H3 in his interview. T4 talked about the ‘all-girl’s construction class’ being an attempt to encourage ‘them’ not to feel intimidated by the boy’s presence.

This year we did not have as many participants. It started off with four girls but clashed with Hair and Beauty so they left. That left me three girls and they had to populate it however. We could think about the lines more in order to stop things that are predominantly girls subjects competing with it (T4).

T4 believed that the two females relied on one another for support. T4 thought they were growing in confidence towards the end of the research period compared to the observations during the bricklaying day when both these females relied on the third female student for direction before they undertook a task. T4 believed the role modelling was from each other.

7.4.5.2 Analysis

Barlex (2007) argues that it is the effect of the end users on the output (artefact) which will have a long term influence on the impact that Technology Education has on students. In broaching the topic of what qualities a female student would look for in term of support or environment in a Technology classroom the reaction of T4 was surprising. T4’s choice to leave that line of questioning showed that it was not an area that was discussed by the Technology teachers. Peer support, because there was a female presence in the Technology department, should be an issue that is clear for the teaching staff. Not continuing a conversation around support, in an area where male teacher was unfamiliar and uncomfortable with the content of the conversation showed how little the issue is addressed. Rothschild (1988) argues that the feminist experience in courses grows through experience and discovery taking place. This feminist experience will lead to new awareness and new approaches to thinking within courses such as this one. In this
case, the students had neither the engagement experience of Rothschild (1988) nor the artefact realisation of Barlex (2007).

Role modelling and the teaching staff’s perception of what attracts females and what may deter them were at odds with how the students saw this concept. High vis. (visual) clothing as a fashion statement is something students want to wear. Rather than being afraid to ‘don the garb of the worker’, the students were quite happy to be seen in these outfits. Hattie (2009, p. 112) in his analysis outlines the teacher effect on students, indicates that, “The pervading influence will in turn be transmitted to the learners”. In the Technology Education department, the wearing of boots and high vis clothing was mandated according to state industrial laws which T4 quoted rather than suggesting a role model scenario.

The composition of the school timetable, and decisions made at an administrative level for the senior school have set up a competition between Technology and hairdressing for students and particularly potential female students. Brief discussions with the timetabling deputy principal did not indicate any bias of gender expectations however the Technology staff were aware of the divide and movement of students when the timetable was published. Paechter (1998) argues that “stereotypical power imbalances continue to exist and that the assumptions and differences between subjects need to continue to be challenged” (p. 114).

The predominant male (T4) view was that the female students relied on one another in the Technology classroom environment. Belenky et. al. (1986) argue that the connectedness of the class encourages female learners through interactivity. There may have been a degree of reliance in their mutual peer support however it was not necessarily evident to the researcher. The female students reported they were not dependant on one another. This was possibly a maturation aspect as they had grown in confidence over the time of the research rather than where they began the course at the beginning of the school year. This argument suggests that the females had gained confidence through understanding the processes and terminology and the environment and they became more self-reliant.

7.4.5.3 Summary

Some issues of peer support were recognised by T4. The simplicity of the decision to have more than one female was not a robust reason as to why females would wish to engage in Technology classes. There is a need for affirmative action around timetabling issues at the administrative level of the school and the need to recruit female staff or teacher aides over time. There were few other role models available.

7.4.6 Socio-cultural approach to learning

7.4.6.1 Results
In discussing the projects that the students had engaged in during the building and construction course, T4 did not highlight the activity of painting the church hall. The female students had spoken in their interview, of this activity as being the most important one.

Yes, that’s their perspective. To them [the female students] that was important, and I think they’re not as cognisant of the process as they are of the end result. Yes, they see the end result not the process (T4).

Yes, but they see the end result that they have contributed to the hall. Is that a female thing more than a male thing? (R)

Hmmm, maybe the end result would be more important to the females than the boys in that situation, I suppose and I guess it depends on the content. The females would have been pleased to make the hall look nicer whereas the boys would have been more involved in the action of it. But we also do a billycart and for the boys the end result would be more important then. It depends on the content (T4).

T4 expressed his beliefs around how the female students learned, via content. Teenage social issues and at times some degree of intimidation [by male students] prevented the females from being as forthcoming in the class as they may have been. T4’s belief was that the listening and processing skills of the females in Technology Education enabled them to do a better job with more quality outcomes than some of the boys. From a socio-cultural perspective it would appear that there was a process which was to be followed and other factors were secondary to achieving those outcomes.

A reflection by T4 on the previous year’s class, and the class which folded (did not continue) at the start of the teaching year indicated that he felt it was external factors which impacted on participation and had a large socio-cultural effect. Some females who were doing other academic subjects were taken off to do tertiary entry eligible subjects. This was an administrative decision external to the department but one which impacted on the participation of female students.

In discussing what makes this class successful for the two females and others in it, T4 stated;

It means that you as the teacher have had to spend a fair bit of time showing them [the females] extra things that they have not known. They have to have the support. And it’s not to say that all boys have not done much more, but safe to say they [the female students] do not know at all (T4).

The researcher questioned T4 about his pedagogy. He was showing the female students processes at every step and in turn increasing their reliance on that learning and teaching style.

Very much so. It feels like you are spoon feeding. Take S4 there, she is very capable but when we were first making a saw-horse you seemed to have to go over that many times. Once it was locked in it was fine but the initial getting her head around it because of no prior experience was challenging (T4).
In discussing the difference between the learning styles of males and females, T4 noted that the female students focus on doing a good job, while males focus on doing a big job. This was evident when the students were doing the angles and the time and precision put into getting the task correct before cutting the materials.

The value of outcomes of the learning activities and what the females wanted to achieve from a socio-cultural perspective was observed as important to the two female students in the class. When asked was the focus on finishing a project or a part of a project, the reply was:

_We saw the females want to get it right, where we saw the boys want to do it, fast or big or quickly. They [the female students] do pay attention more and try to look for quality (T4)._  

### 7.4.6.2 Analysis

Murphy (2007) and Wajcman (1991) would argue that the construction of masculinity has affected the practice of technology. T4 did not recognise the value of the church hall painting to the female students. He failed to understand the appeal of firstly contributing to the social aspect of the community in which the students lived and secondly that the students were given an opportunity to aesthetically improve an environment. Undertaking the project was a positive, but failure to recognise its worth shows the difference between teen females and the white Anglo-Saxon male teacher. Process versus product, and what one values in terms of content specific nature of the course remains the domain of the male dynamic (Talbot, 2010). T4 raised the billy-cart issue, and its appeal to male students, while this was intended to be an equitable statement it is illustrative of the value placed on a male preference project above another.

In terms of how female students engaged in the projects that were part of the course, T4 saw the difference between male and female learners as listening skills. Not standing out in front of the class but assertively having a place within the group appeared to be a behaviour that the two female participants employed. Teachers were aware of past intimidation by males and there was care taken with the participants that this would not occur in the class. Peer relationships in this group and age as teens appeared to be a factor which influenced some interactions within the class. Toft (2007, p. 288) quotes Murphy (2006) where she focussed on the different perceptions which teachers and students have of technology. Her findings from neuroscience refer to the “subtle ways students develop meaning’ based on the collection of their own experiences” (2007, p. 288). Gender is socially constructed. Genetic research out of America indicates the differences in brains of girls and boys. Toft argues that if teachers personalise learning they may help males and females to progress in Technology activities. His claim is that “teachers are bounded
by their perceptions of masculine and feminine behaviour, that is, bounded by their socio-cultural origins” (2007, p. 289).

The administrative decisions made by the school appeared to impact on the membership of the class. These decisions also reinforced the Dakers’ (2007) argument of “brains over braun” (p. 92). When the school diverted, brighter (more academically able) females away from this class they made a social statement as to the value of OP (overall position for tertiary entrance) eligible learning over Technology Education. The message for Technology educators is that these subjects also need to be in the university qualifying range of subjects as the subjects they compete with are.

Rothschild (1988) argues that women’s experiences must critique contemporary technology. More voice needs to be provided for the female students. This should be in two forms. Firstly, in encouraging female students to be more independent learners, taking real risks, and, secondly, in providing feedback to the teacher. Rothschild’s argument that feminist language and ideas had been mainstreamed in the era of the 1980s needs revisiting in this current decade in order to re-build gender awareness. The notion that classrooms are the ideal places to do this may be correct if there is a culture of inclusivity and feminist teaching methods amongst teaching staff. The pedagogy of teaching female students was illustrated in the teacher’s belief that he needed to demonstrate to the female students at every point. The students knew to wait and this action reinforced the notion of the master apprentice relationship in the class. T4’s belief that the completion of a project from a female perspective as against how boys approached projects was the key point of difference failed to explain how the gender difference was being addressed. The explanation lacked a depth of analysis as to why and what he could possibly do to change this.

In order to cater to gender, there needs to be a greater focus and value on the outcomes of the learning activities which the female students engaged in. This focus should be holistic as well as on the processes involved in the activities. The precision of ‘getting it right’ is what the female learners wish to achieve. It would appear that this standard of achievement was driven by the teen female peer culture in the class. Belenky et al. (1986) speak of socially valuing how females learn rather than learning it the way males see it.

7.4.6.3 Summary

There was recognition on the part of the teacher, that different genders approached projects differently however there appeared to be a lack of understanding or recognition that the female students in this class were seeing things from a different perspective. T4’s
socio-cultural perspective was from the white Anglo-Saxon male teacher in a system which supports a lock step approach to learning.

The following examines values as expressed by T4 in this case study.

### 7.4.7 Values and Technology Education

#### 7.4.7.1 Results

Values, as a concept, was not a topic that the teacher wished to address on the written response sheet. In the interview, T4 suggested that it was one we could leave alone for a while. T4 asked were we talking about environmental values. The researcher expanded on the term ‘environment’ as an example of one resource being valued more than another, for example one type of wood as against another or wood as against steel. The response was, *It’s just industry is what we use and I guess you could look more globally. We don’t discuss that as much as we could in that it is a sustainable resource and it is a quick growing timber* (T4).

The discussion continued about the value of resources and how few Technology and design students seem to be aware of the term or its extended use. The teacher said;

> I don’t think you would find too many apprentices that would be talking about it as against, ‘there’s a pallet of pine studs and we’re building this house’. The reason being that’s what they are given by the boss. Having said that, at our level, that’s a pretty good discussion to have (T4).

#### 7.4.7.2 Analysis

T4 indicated he was not clear about values as a concept and what it would cover. When the researcher clarified that it could apply to the type of resources used and how they were valued, T4 expanded on his comments. The commentary related to the use of materials in the physical sense. The discussion was not about how students, particularly female students, would put a value on resources or their engagement with them. Ritz’s (2009) argument, which related to goals that describe the social, ethical and environmental impacts associated with the use of technology, are significant and students ought to be technologically literate in this content area.

There appeared to be hesitancy on the part of T4 to discuss the issue of values other than where it related directly to the products being used in the projects. Pavlova and Pitt (2007) argue that in not teaching for sustainability we are ignoring reports on climate change that point to the need for ecologically sustainable development. Technology argues Pavlova and Pitt (2007) is the key to the relationship between humanity and nature. It is education which provides the frame of mind in which future generations can be made critically aware of the role they play in a long term sustainable environment.
7.4.7.3 Summary

In terms of values within Technology Education, T4 did not appear to be aware of the breadth of the concept. The term was recognised by T4 once the researcher provided an example however there is an aspect of in-service training and information which could be provided to expand the knowledge of the teacher. In turn, student’s knowledge of the aspects of values and goals would expand so that their personal goals expanded and they are not limited to a trades and industry focus.

7.4.8 Summary T4

The learning ecology in this case study encompassed many of the elements that this thesis has outlined in terms of effective, positive environments. It was a supportive surrounding, with peers who appeared at times to mix with one another, positive student teacher relations, resource rich venues with tools appropriate to the tasks at hand. What it lacked was a cohesive group dynamic and independent, individual motivation that saw students making key decisions about the project.

T4 acknowledged the differences between teaching and the engagement of male as against female students in this area of Technology Education. T4, along with his colleagues did not perceive that their teaching practices needed to alter because of the class composition. T4 afforded the girls time and support which in turn aided their confidence in engaging in the subject. He failed to analyse the long term social factors which were important to the female students instead focussing on the objectives and outcomes of the activity.

Language was focussed on tasks and not seen by the male staff members as anything that needed to be altered or that would be changed because of female participants. Given the extent of masculinity of the prevailing culture in this case study there was no acknowledgement of any need for change.

The presence and motivation of the females appeared to be attributed to their sense of worth rather than what teaching practices contributed to their place in the class. While this study believes that there is a need to find a place for females in Technology it is practices which heighten motivation which are the enablers that encourage participation. In this situation the external motivators were lacking. The motivation to be in the class came from within the individuals. The female students did not exercise a voice. They did exercise a presence and they wanted quality work and precision to be part of their achievements.

Some issues of role modelling and peer support were recognised by T4. The simplicity of the decision to have more than one female was not a robust reason as to why females would wish to engage in Technology classes. There is a need for affirmative action for timetabling issues at the administrative level and the need to recruit female staff and female teacher aides over time to further the aspect of positive role models.
There was recognition on the part of the teacher, that different genders approached projects differently however there appeared to be a lack of understanding or value by T4 that the females in this class were seeing things from a different perspective. The socio-cultural perspective was from the white Anglo-Saxon male teacher in a system which supports this approach.

In terms of values within Technology Education, T4 did not appear to be aware of the breadth of the concept. The term was recognised once an example was provided however there is an aspect of in-service training and information which could be provided to expand the knowledge of the teacher and in turn the students. There was a narrow trades and industry focus in this case study. Expanding on content in this area would advantage students with respect to students understanding the use and impact of Technology in their content and process work in Technology Education.

7.5 Case Study 3 - Head of Department (H3)

H3 made the departmental facilities, the staff members and the classes available through arranged times and visits. All of the staff were male and were happy to talk about work in the department and their students. There was little time to talk with staff and they used their own time to meet with me. The lunch breaks were rushed due to staff assisting students and getting resources ready. Students were valued in this setting and staff gave extra time to assist them where possible, using their own time.

H3 met with the researcher individually to look at the interview questions and discuss them. He was an older experienced teacher having taught for over 25 years. H3 appeared to be well respected amongst the staff and community.

7.5.1 Learning ecology

7.5.1.1 Results

There was an acknowledgement on the part of H3 that, if females were to be part of the Technology learning environment, that some practices needed to be done differently. H3 however, like T 4 lacked the operational ideas as to how to change the community of practice in order to encourage more female students.

Some time was spent discussing the environmental value of resources which the students had available to use while in the Technology Education department. The interview moved to the cost impost that may impose an economic value on students. The discrepancy between the real world of work and the real world of education and the causal nexus between the two is where H3 sees himself working, in instilling in the students the use of the skills they
are learning now and for later use. The conversation turned back to the unit where the girls were painting the hall and then putting up the wall. The females said,

*Oh I went home and could see where that would work (S5).*

It was the empowerment, *The oh, yes I could do that.* H3 went on to report that the focus was vocational work for the class which the females were in.

### 7.5.1.2 Analysis

Brown (2000) in his writings speaks of developing a community of learners within a learning environment where Technology creates the relationship between learners. Regardless of the nature of this class as a physical production of Technology class as contrasted to Brown’s digital communities, the importance is that there is a shared community of practice and that the learnings are part of that ecology.

H3 felt that even though female students may not take up learning in the Technology area during their formal education it might strike them at a much later date that they can use the skills they have learned. This is at odds with the vocationalism that H3 reported the course as promoting and reinforces the divided nature of gender which the environment appeared to be promoting. Dakers (2007) argues these same issues.

### 7.5.1.3 Summary

There was an identification of a community of learners within the Technology Education learning area. The identification was between H3 and staff but did not extend to knowing the female participants well. H3’s concern and focus as a manager was about how he could best shape the department and its programs to better cater to more participants. His view of the learning ecology appeared to stem from the replication of real world learning and their goal of achieving vocational education for their students (H3 used the term clients).

### 7.5.2 Gender and technology

#### 7.5.2.1 Results

H3 talked about the past where females did Home Economics and males Manual Arts; and never the twain would meet. The gender divide.

*That’s completely gone by the wayside now. We, the Technology staff, see everyone at some point. Everyone comes past our door. When we get into Years 10, 11 and 12 that’s when it starts to tailor and we would get down to 10% of the females (H3).*

H3 was asked during the interview if there was more that the staff could be doing to promote the subject to females both now and over time? The question was posed would they encourage
more girls into the senior school if you promoted, sold off or advertised what the senior school students are achieving to the junior school students? Is Technology Education visible and does it have a high stakes reputation for females in the school community?

We need to be doing a whole lot more for ‘our ladies’, with regard to the take up of the subject. You are absolutely right but the thing comes down to the tyranny of time which is always against us, which is not an excuse. The conversation that quite often happens in the staff room is; in today’s climate things are added into the basket but nothing’s ever taken out (H3).

Whatever you choose to do with that [promoting females and the subject], is done outside of the normal realms of what you are doing in classes rather than it being part of what you are doing in teaching. It is very much ‘a girl’s thing’ that it (technology) is not for them. They still think it’s not for them (H3).

For example you see the push that is happening at the moment with the armed services trying to get women in and they are still having devils own job trying to get women in even though they have got different ways to get them in. To get them [the females] into purely male bastion areas is difficult to change that mindset. The same correlates directly to apprenticeships, apprentice electricians. Up to 63% was the last figure I heard was the dropout rate. More than half who start do not make it to get their papers. That’s wicked if more than half the kids that start don’t make it through (H3).

H3 went on to talk about the suitability of a trade such as bricklaying for females. The masculine world view to such a trade was evident during the day the trade bricklayer spent with the class. In introducing the whole day workshop to the students, he said; Oh, we do have girls but you know there’s heavy jobs (Bricklayer).

This did not deter the three girls who were present from engaging in the day’s activities.

Catering to females in the Technology department was explained by talking about factors such as female suitability for some trades and skills;

What we are trying to teach here is ‘working smarter, not stronger’. Those who are a little bit enlightened with regard to things nowadays know that you don’t have to be a big muscly thing to do the heavy hill work. There are ways to get it done, you don’t have to do the heavy lumping (H3).

In considering the vocational education that’s one of the school links for post school options for students with regards to the courses that will come into the trade training centre. We [Technology staff] have looked through the bureau of statistics with regards to the future projections and employment, shortages, workforce shortages …and we try and tailor our subject areas towards that because our prima face objective is to gain employment for kids who are interested in those spheres of work. Then if we can, we have done our job. If we can’t then we have made a mistake. So at the moment it is all in the construction trades (H3).

H3 discussed his ideas about product (artefact).

Unless we’re offering a product that the kids want and the kids see as desirable; (Yep) whether that’s skills or vocational we won’t have anybody standing with us. We’re an elective area and so as an elective area and now we fight against every other elective area for numbers. So that in itself becomes a sort of ‘domiciles’. If we are not
providing a good product, if we are not providing good service and if we are not providing entrance then we don’t...don’t get them coming in the front door, and if we don’t then I lose staff. It’s all about being innovative enough from the gentlemen (teaching staff) as well (H3).

The conversation with H3 discussed the staff needing to link with other curriculum areas in the school in order to meet the schools focus as an Asian partner school. Some investigation was being done about making Japanese boxes and other cultural projects that may fit with the sister school links that the school has established.

7.5.2.2 Analysis

It is a positive step that all the female students in the lower school come through into the Technology classes at some point. The concerning issue is the 90% reduction in those who come into the classes in the senior learning area. Given that the department claims to be catering to trades, the flow on appears to have little appeal to female learners. Female learners appear to want to value of the subject for life-long learning. Changing mindsets would appear to be a necessity for the staff. Rather than empowering female students to believe that they can do the tasks, the need is for pedagogical change to alter the focus of the task itself. Ritz (2009) would argue that “the goal has not been updated to meet the needs of changing knowledge and changing social circumstances for students” (Ritz, p. 62).

The notion of the masculinity of the class as argued by Dakers (2007) has not been achieved in this department. In reflecting on the HOD’s expression;

*It’s everyone’s business to own equity issue for the Department* (H3).

When H3 talked about promotion of the subject, he talked of ‘the tyranny of time’. H3 saw addressing gender issues as something that added to his and the staffs’ workload. His preferred thinking was if you do a positive job that appeals across the gender spectrum then students will come along and join the class.

*It is not just the Design and Technology teachers who should be dealing with the issue [equity].* (H3)

In this case study, the concern about females in the subject initially came from the Principal. During the year of the study, this concern was not translated into a female class via the timetabling. The administration aligned the Hair and beauty course with the construction class. To implement and execute any program requires alignment and support at all levels of the school.

The inference made by the trade bricklayer trainer working with the class teaching trade skills was that this was a ‘boy’s area’. His repetition of the need to scale heights, hot work and heavy lifting was intended to show that it was a tough ‘male’ occupation and he was looking for a keen male student. This message was not missed by the female students (S4 and S5) who
repeated this statement during their interviews with the researcher. Dakers (2007), argues that whilst vocationalism is a complex debate it is not about job training within Technology Education (2007). This point is at variance with the stated beliefs of H3 who sees his reason for maintaining a strong department as having numbers of students present and being trained for a jobs market according to the statistics they have accessed. He failed to look at how this may suit many of their female students or to relate to associated trades which female students would identify with.

The type of pedagogy that H3 wished to impart to his teachers, and, in turn, to his students, was teaching about working smarter, not stronger. This aspect of pedagogy change is where the HOD (H3) believed the Technology staff needed to be progressing in order to appeal to all learners but especially their potential female participants. How they were to do this was seen as the time issue expressed above by H3. It was the changing of pedagogy as argued by Murphy (2007) that will appeal to female learners and strengthen the Technology department.

Focussing on product and producing something that kids want to consume in terms of a viable course in Technology Education was the beginnings of catering to a more female oriented curriculum. Murphy (2007) argues that what students pay attention to can alter the Technology department. Similarly H3 recognised the value of numbers of students in the department which would in turn maintain resourcing in the Technology department. He did not see the need for female oriented products.

H3 did recognise the importance of communities of practice however his use of terminology such as ‘gentlemen’ and ‘our ladies’ would not fit with Brown’s (2000) boundaries of developing an identifiable community through the use of gendered terms. Similarly it would not accord with the identity issues as promoted by Wenger (1998).

Curriculum content, such as making Japanese boxes with a distinct purpose of providing a product for the school to gift to their Japanese guests, may be seen as more worthwhile by the female students than many of the males (Murphy, 2007). Such a focus may provide a motivational factor for female students even if it were a one off activity. It would not appear to be a long term viable reason to engage female learners nor male participants in Technology Education courses.

7.5.2.3 Summary

In terms of gender, there was a clear message that female participants met a need when they were part of the Technology department. They met a numbers target as much as the possibility of strengthening the capacity of the Technology department. The problem appeared to be that there was no clear message as to why the HOD and staff thought they should be there in terms of completing trade or skills training. H3 failed to see that visibility and community oriented tasks based on intrinsic and extrinsic motivational goals could be relevant. Jobs that may not
appear to be directly apprenticed to the technical arts area could be judged as factors which may entice female participation. The following examines the language use as discussed with H3.

### 7.5.3 Language

#### 7.5.3.1 Results

This topic was not addressed directly in the interview with H3. During the discussions however, such as those reported above in the dialogue with H3 terms such as ‘our ladies’ were used as an accepted term but one that made the difference in gender very clear. In expressing his thoughts on what it was that the female students wanted H3 did provide a certain view with respect to language use.

#### 7.5.3.2 Analysis

Talbot (2010) argues that the existence and use of traditional honorific titles for women are in contrast to the titles for men. According to Talbot, “This is exacerbated by terms of endearment and reflects the unequal treatment of men and women in society” (p. 15). The language used by H3 about the female students did point to the gender differences and his approach to females in Technology Education classes. H3’s use of Technology terminology was helpful and explanatory when explaining technical terms to staff for the female students. There was however, no recognition that H3’s or the staff use of language could be seen as creating any dualism.

#### 7.5.3.3 Summary

More attention needs to be given to this concept in terms of Technology Education with regard to ownership and use of language for Technology with regards to who are the dominant practitioners in the profession.

The following examines the theme of motivation in terms of the HOD (H3).

### 7.5.4 Motivation

#### 7.5.4.1 Results

Students in this school were different to those in the other two case studies. The location of the school was in the outer suburbs and the students were mostly from working class backgrounds. Historically the students were not always seen as having a long term goal due to the apparent lack of employment opportunities in the local area.

*The unmotivated are the unengaged. Those who are motivated come along, are prepared, are engaged and active (H3).*
H3 explained that they [the Technology department] were busy making ‘demos’ such as picture frames in order to put students work up on the walls in the school foyer as self-advertising for the subject and its participants. Motivation for these students comes in the pride of participation in projects for the school.

...the general public or anyone who comes through the school can see kids enjoying themselves (H3).

H3 indicated that he looked for a desire in students to make a product as much as, be that product for the department in the school. He talked of the desire for students to want to come to the door of the Technology classroom. The discussion went through the artefacts of the wooden inlay Japanese box as against the clocks and LED lights that were being undertaken in other sites.

The following dialogue from H3 illustrates that skills over artefacts is important to this Technology department and its focus.

With regard to design Technology it is pretty much what our subject is. It is so much more about building a better mouse trap than building a new mouse trap. The ability to go through now-a-days and build something totally and utterly new that has never been on the face of the planet is difficult in whatever sphere one’s from. That is why we are on about improvement (i.e., building that better mouse trap). That’s why you’ll still see clocks, you’ll still see...... the other things that go with it. There is also the certain amount of not what the project is. It’s the psychomotor skills that go into making that project. So if its mum’s dustpan from 1932, it’s the actual hand skills that go into it, it is the psychomotor skills that go into it as opposed to the finished product. I then use the rule that if it is useful to the kids and is aesthetically pleasing to the kids. We’re all about hand skills (H3).

7.5.4.2 Analysis

Nicholl and McLellan (2009) argue in relation to English school students in the United Kingdom system, individuals who were not challenged, had little autonomy, and did not have their ideas in design and Technology adopted. These students had little, if any motivation to engage. The staff of the Technology department believed they were catering to the needs of the local community and students who studied in the department. The type of student that the school attracts and that the Technology department have traditionally been allocated has not always been the most school accepting or motivated students. Student expectations and staff expectations have been relatively low however it would appear that this view is changing.

The Technology teachers appeared to aim to motivate their students by instilling a sense of pride into the participants by engaging in projects which others can see. People from outside the department, in the school and community, valued the Technology activities as they served a practical purpose around the school environment. Pintrich and Schunk (2002) in reviewing low socio-economic status, gender and ethnic differences in a number of studies in relation to motivation through expectancy and values did not believe there was one single solution.
Pintrich and Schunk (2002) cite the need for further research in relation to youth beliefs in themselves and actual achievements. While these studies focused on Afro Americans and English students they concluded that females placed more value on the subject focus of liberal arts while boys was sports and activities.

One must concur with Dakers (2007) that the subject area is not one for only males or only vocational. Design and Technology is a school subject which introduces commerce and industry rather than education for specifics. There needs to be a critical view of what the students are doing. Students in this site were viewed as the product as much as them making products as outcomes of their work. This was the first site and first HOD (H3) who stated that this was how the staff viewed the students. It was a short term, in the present view. This is in contrast to the long term view that Case Study 2 looked at, as to where their students were headed in terms of post school options and tertiary studies. At the same time the skills preparation for trades in the boys did focus on the work readiness in this site. The concept did not appear to extend to the girls and their learning outcomes.

The focus on hand skills regardless of the artefact is almost at odds with the wish to have a greater female participation in technology. It was not cognisant of what H3 and T4 had indicated in terms of females completing aesthetically pleasing and accurate jobs. H3 appeared to overlook the creative aspect of design. H3’s dialogue did tie in with the staff having overlooked the concept of females feeling that their contribution to Technology was through community rather than through mastering skills. Pintrich and Schunk (2002) would argue that peer mastery as well as gaining success through watching teacher’s modelling will heighten the self-efficacy of students and these students outperformed those who had no modelling. Same sex modelling will further enhance learning activities for that gender.

7.5.4.3 Summary

What was reported and observed with regards to motivation in this case study was at times conflicting. Placing a focus on time to motivate and promote the Technology area is not an accurate measure of how one builds student motivation. Placing a focus on teaching for trades does not cater to all the Technology Education participants, particularly the female students.

7.5.5 Role modelling and peer support

7.5.5.1 Results

Peer support and role modelling was discussed in the context of the school having run a whole girl’s class the year before. The single sex class did not operate during the research year due to timetabling factors in the school. Female students wanting to do OP subjects (academic entry qualifying subjects) were sent to other subjects and the composition and characteristics of the
Technology class altered. The school administration, based on the findings of the class the year before believed there was a need for more than one female in the Technology class.

We need to get more girls into the subject. The biggest thing is gender and the gender bias that we still have. People may say it is gone but if one looks at the machinations with outcomes (our past Prime Minister) whether that is because of her political alignment or because she has a dress on. I look at it that people see because she has the dress on. If we’re still as a whole county fixated on that – we have a long way to go.

Educationally, in order to bring girls forward and as much time and money that has been expended on gender equality. The abilities of the ladies to earn equal dollars are different. Yep. As I said before there is no reason why a girl should not be a carpenter, shouldn’t be a plumber. The only thing that stops them…. is a lot at home. No you don’t want to do that, no that’s not for you (H3).

During the interview the discussion turned to staff and the female staff member who gained a HOD position at one of the newest high schools. H3 said;

We are over the moon she was really good, really efficient, really knew what she was about and the gender focus was a positive, and now she has made Head of Department. Not only was she good at doing the ground floor but she has achieved (H3).

H3 stated he would have a female staff member any day. The female students had both noted in their interview that there had been a female teacher in the department; but she’s gone (H3). H3 like the female students and the school believed that a physical role model did make a difference. She was in his words, a role model who is breaking the model (H3).

7.5.5.2 Analysis

Pintrich and Schunk (2002) argue that modelling does not occur automatically. Peer support from the past years was recognised as important by H3, the Principal and the administration. Unfortunately the timetable appeared to be the factor which altered the characteristics of the class with regard to more females participating in technology. H3’s reflections were as much around the socio-cultural view as they were about role modelling the apparent lack of respect awarded to females. This included females in positions of power such as his comments around the female Prime Minister. It is the historic nurture and home factors which H3 indicated were the main influences on girl’s participation despite programs and funding that are put in place to adjust to issues of equity.

Up to the year prior to this study, the Technology department had a female staff member and it was this teacher who was attributed with much of the success of the all-female class. The success factor was that female students wanting to positively engage in Technology learning. The apparent efficiency of this teacher not only placed her well in terms of a role
model but also as a model of competence as described by Schunk in 1987 (Pintrich & Schunk, 2002).

This thesis suggests, consistent with Murphy (2007), that the role modelling factor needs to be linked to the motivational, enthusiasm and enticement factors that would similarly heighten female participation. H3 expressed the need for role models in order to have more females participate in the senior area of the school. The junior school saw all students enter Technology Education classes however there was a need for some enticement at the senior school levels.

7.5.5.3 Summary

While recognising that role modelling is important for female participation the staff of the school and the Technology department did not believe they had the resources in terms of time or physical initiatives, to actively put processes in place to address the lack of female examples. The department needed to refocus their efforts through highlighting the achievements of the female students who were already engaged.

7.5.6 Socio-cultural approaches to learning

7.5.6.1 Results

In discussing the artefacts the students were making the question was asked as to whether the made item was more important than the process.

No, said the HOD.

_The opposite. It is all about process, not about finished product. The only thing that comes into the finished product is we’re are selling a product and the product we’re selling is ‘knowledge and skills’ and to make that more appealing the end product has a bearing on who takes and who doesn’t take the subject. So if we’re able to make that big, and bright and shiny then the bower-birds will come along and take a look, if not they shun it (H3)._

When H3 was asked what would make a difference to the students he was adamant that if the junior school students saw what the Year 11 and 12 females and males did in Technology Education then more students would join the courses.

_Absolutely! Absolutely! That not only comes into the building and construction sphere and the civil construction sphere that is the take home. As in, they don’t take the dog kennels home. They produce the dog kennels and we take photographs of students standing alongside them and tell them what a splendid job they’ve done and we turn that money back into the subject again for the following year. If they make cement paths or paving or build the cupboards that they are building at the moment, underneath the building block then they get to see their work forever. We tell the kids about pride in their work and that gets to stay there forever and ever which is more important than a trinket box that you might make (H3)._
The teacher joined the interview while on his lunch break.

*I think the kids in lower socio-economic areas seem to have lower values. A lot of kids in this area are multi-generational unemployed. Anything they have ever got they have been given. It’s brand new. It’s been given from a source somewhere out there. Whether that’s baby bonuses or welfare so there is no value. I wonder about the impact (T4).*

7.5.6.2 Analysis

H3 was insistent that what they [the Technology teachers] were focussing on was the process of learning. The discussion was over whether process or product drove what occurred within learning. This is consistent with Murphy writings on learning and gender. When H3 says they are selling the ‘knowledge and skills’ it illustrates the learning that is inherent to the Technology learning area. Murphy (2007, 2009) would indicate that females in Technology Education are motivated by the socio-cultural factors, the acting, talking and being, before processes and skills. Murphy talks of learning “as a process of meaning-making. Teaching in this realm is then dynamic and created as a process between the teacher and learner in engaging activities” (2007, p. 239). A female trait based on socially learned characteristics.

Banks (2009) examined research on gender and technology in Europe and reinforces the argument that has been progressed in the thesis. The value placed on the nature of Technology would have a different meaning had female students had similar experiences and encouragement relative to male students. The socio cultural aspects of learning as discussed by H3 were the activities that were valued more than others. These were products that could be physically seen by the students and the community in the school setting. Idea of students seeing work that has been completed by the Technology construction group, and knowing who contributed to that work may be more influential for junior school female students to see and understand.

Williams (2009) argues that education serves to transmit cultural norms to the next generation. In a technologically dependant world the prevailing transmission will be increasingly technological, with participatory skills developed in technologically literate people in order that individuals reach their fullest potential. The needs of the school and community and the values upheld by the teaching staff tended to shape the curriculum and learnings from an organisational point of view in this case study. Students may be stereotypically locked into not only the generational phenomenon of where they live, but a cultural norm reinforced by the pedagogy and educational system that is imposing this same culture on them.

7.5.6.3 Summary

The influence of gendered views, of traditional cultural views of females and males were at their highest point in this theme. There was traditional and bias gendered view of what females engage in that stems from the community in which the students and the school see themselves
immersed in. This view remains ingrained in the ‘industrial’ trades Technology which the school appeared to promote.

7.5.7 Values and Technology Education

7.5.7.1 Results

The future employment direction for the Technology department was seen as heading towards trade based teaching. In discussing values with H3 he explained that the other thing in the senior school in particular is that it, [the course] may have an end game.

That’s a difficult thing for us at the moment as the building and construction industry is having its problems. Hmm. So where at one time we could have been placing four or five kids into the Building and Construction industry out of our courses now if we place one or two a year we are doing brilliantly (H3).

H3 explained the vocational value of what they as Technology teachers aimed to do.

We have had one student exit school in Year 11 at the end of semester 1 who was able to take up a role as brick layer. The bricklayer had a look at two of the kids that we said had some skills and interest in it [bricklaying as a trade] and offered him an apprenticeship. It never goes on our books with regards to statistical data but for us that makes up part of our end game. If we are a vocationally oriented subject area to see our kids gain employment and place for us to see our kids is important (H3).

In questioning H3 on his future views and goals for vocationalism in Technology, H3 replied;

There are two things with it. It’s a guilt edged sword. For those who choose to pursue a career in the subjects we’re teaching towards fantastic! For those who want some fine motor skills, some knowledge, some handyman skills that they could use at a later date or for all of us I think we would rather change from childhood to adults with the knowledge and skills we are equipped with. They may not do something with it until they are 25 or later and then say, oh I remember doing that, and they’ve got some knowledge and background (H3).

7.5.7.2 Valuing resources

The researcher questioned H3 about valuing resources as observed while working with the students. Several times they were asked; is this bit of wood important to you? The students didn’t have a concept of what they were using or that they are using something finite.

You’re talking something environment? No, I wish I could say that every child valued what they were given and where it comes from and how long it takes to grow but the amount of money and energy that is put into having those things. That is the Y generation. Though I have heard these guys referred to as the C generation with regards to connectivity. Conceptually no I don’t think they are great environmentally (H3).

The researcher had the following discussion when asked how students in other sites compared on this aspect of values.
... you know there was a fair bin of stuff in terms of wood offcuts and resources that were put into the waste bin, left there. The students saw it as the throw out bin rather than the reuse bin that the teachers referred to. They didn’t get it when I said to them why don’t you go and look in that bin. It was well; why? There’s new stuff over there (R).

The children look at it as ‘the bin’, the staff look at it as an ‘opportunity bin’, without a shadow of a doubt. There is an opportunity to recycle, reuse, rename (H3).

7.5.7.3 Analysis

H3 believed that differentiated Technology Education was the future employment direction for the students in the Technology department in terms of trades and jobs. Banks (2009, p. 386) argues that “reinventing curriculum must be based on effective learning demands and feedback”. There did not appear to be a value assigned from the staff to encourage females into these areas as evidenced from the bricklaying workshops and outcomes.

Vocationalism and where Technology Education could assist students as an extrinsic motivational factor was a value which H3 came back to in the interview. Dakers (2007), and Dakers and Dow (2009) questions the purpose for vocationalism in terms of what value is placed on the curriculum and the different spheres and how they are perceived. When vocationalism takes place in an academic setting for the purpose of subjects such as architecture it appears to be more highly valued (2007). One must concur with Dakers (2007) when he says, “Technology is not a poor cousin to academic education which seeks to offer an alternative, less rich experience designed for the less able” (p. 106).

Future views of Technology and the environmental values of Pavlova (2009b) and sustainability were discussed in H3’s interview. Staff in the Technology department were aware of Pavlova’s (2009b) views and of her writings on ecological sustainable development. They did not see these concepts as values which could be applied to what they would teach students.

Yes we have talked about values (H3).

The researcher noted with H3 that students had been asked how they worked with the resources they were using.

I would say to them, you know is this bit of wood important to you? They really didn’t have a concept of what they are using, that they are using something finite (R).

The view of recycling and re-usability and valuing resources links to the handout notion as discussed in section 7.3.6 of this thesis, under the socio-cultural approach to learning. There is a need for pedagogy as promoted by Pavlova (2009b) that educates individuals and communities to conserve, reuse and recycle for ecological sustainability. The example of the waste wood bin was the catalyst for re-use and placing a value on the items the students had
available to them. The story of the ‘welfare’ and ‘hand out’ expectation of the students meant that little store was placed on repurposing or reuse by the students.

7.5.7.4 Summary

Values as a concept, while varied, have been interpreted in many different ways in this case study. The notion of end values was an objective of the staff. Goals or achievement values were a key driving concept to the students. The short term immediate values of pride in finishing a job that could be viewed in the community were acknowledged by the staff and students. Sustainability and recyclability was not a factor that appeared to make a difference to students as against H3 seeing the waste bin as an opportunity for not wasting wood and resources.

7.5.8 Summary Head of Department 3 (H3)

There was an identification of a community of learners within the Technology Education learning area. The identification was between H3 and staff. The view did not extend to knowing the intricacies of the female participants or learning styles. H3’s view was about how he could shape the department, its learning ecology and its programs to better cater to more participants. His view of the ecology appeared to be limited to the replication of real world learning for apprenticeships.

In terms of gender, there was a clear message that female participants were needed to be in the department however there was no clear message as to why H3 and staff thought they should be there in terms of completing trade or skills training. H3 failed to see that visibility and community oriented tasks and jobs may entice female participation.

More attention needs to be given to the concept of language use in Technology Education. This was relevant with regard to ownership and use of language for technology. Male teachers and male students held this knowledge while the female learners had to seek out the explanations.

What was reported and observed with regards to motivation in this case study was at times conflicting. Placing a focus on time to motivate and promote the Technology area is not an accurate measure of how one builds student motivation. Looking toward what may motivate individual female students and what they valued may be an important message for H3 in this case study.

There was some recognition that role modelling is important for female participation however little value was actively being put in place to address the lack of examples of female role models. The department needs to refocus their efforts through highlighting current achievements.

The influence of gendered views, of traditional cultural views of females and males were at their highest point with regard to the socio-cultural approaches to learning. There was
traditional and stilted gendered views of what females engage in. The social view of contributing to the community in order to add value for individual self-worth was overlooked. What remains ingrained is the ‘industrial’ trades Technology which the school promotes.

In terms of values, the concept while varied has been interpreted in many different ways in this case study. The notion of end values is an objective of the staff. Students need jobs and in this case it was trades for male students. This was a concept held by the staff as a key driving force which did not always extend to the students. The short term immediate values of pride in finishing a job that could be viewed in the community were acknowledged by the staff. Sustainability and recyclability was not a factor that appeared to make a difference to students.

### 7.6 Case Study 3 - Student 4 (S4)

S4 was a sixteen year old student. S4 had done some manual arts in Year 9, none in Year 10 and had joined this class in Year 11. The interview with the two Year 11 female students was during their class time near the end of a teaching day. The classes the researcher had participated in with the female students were at times noisy with machinery running. Usually the students were very focussed on the task at hand so there had not been large amounts of recorded dialogue. Noise and lack of time meant it was difficult to interact with these students except when engaging with them in their projects. The interview was the first time the female students had openly talked with the researcher. Being away from the class seemed to make a difference to their engagement.

#### 7.6.1 Learning ecology

##### 7.6.1.1 Results

This class utilised the concrete apron space at the rear of the Technology building as a classroom setting. The stairwell within a two story building was where the group were undertaking their construction project. There was not a specific classroom. The class used a science lab on the first day where the outsourced brick layer trainer showed a video, another day was a library annex for the wall planning lesson.

S4 talked about designing saw horses and completing the theory part of their certificate work and questions in the hand books they were provided. S4 also participated in the practical side of the course. She enjoyed the book work and answering the questions.

What this student reported she liked about the class, in particular, was the hands on practical work. During the observation period the students were observed making decisions within the designed projects however they appeared to rely largely on the direction of the
teacher. This applied to the female students more so than the males. This links to T4’s comment that the two females aimed to make their work perfect ahead of the males.

7.6.1.2 Analysis

S4 did not believe that the learning ecology as defined earlier and described by Siemens (2006) in terms of the environment could be improved. She understood this to mean the physical environment. She felt that the number of people in the class was a good number for the spaces they worked in and that she was able to work both independently and in a group.

Belenky (1986) quotes the French feminist writer Duras in stating that, “women will take in conceptual themes but they need to find their own words and make meaning of their experiences, which will take time” (1986, p. 203). There was a hand book of work to complete. Once students had reached that competency level they had the book signed off. S4 saw this as an individual achievement. S4 reported that she enjoyed the individual book work. S4 also felt that she had an opportunity to design what they did however there was little evidence of any of the projects appearing to be different from each other. It was a positive that the student felt she was able to participate in the design phase. In essence, as a female student she interpreted and observed the ecology differently, and less critically, compared to the male students.

There was a competitive element in this environment between the males and females during their practical work. T4 and H3 noted that the female students aimed to get what they did perfectly correct in order not to incur any negative comments from the male students. S4 knew she would be well supported by T4 but it appeared that there were underlying notions of self-confidence. These may have stemmed from the gendered peer interactions.

7.6.1.3 Summary

In terms of a learning ecology S4 became more settled in the class environment. This was evident towards the end of the period rather than earlier in the teaching year. S4 felt supported by the male teacher.

7.6.2 Gender and Technology Education

7.6.2.1 Results

S4 reported that she thought the unit they were currently studying (construction) would be about how to work safely in a building and construction environment.

When S4 was asked - what did she believe were the teacher expectations for the students in the class? - the response from her was:

*To make sure that you know.... (S4).*
When asked further about ‘knowing’ the response was;

_We’re smart, boys use their muscles and not their brains and we know the standards that the teacher is expecting (S4)._ 

### 7.6.2.2 Analysis

Belenky et al. (1986) argues that if teachers engage in connected teaching that allows students to take risks, find holes and meet standards through their own voices then they would be on a pathway to an attainable activity. If the teachers are females there will be far greater opportunities for models of thinking. S4 had joined the course with an entirely different view of what she would be engaged in rather than what she was doing in the Technology class. This lack of understanding, or failure to know what the course may entail, could have been a factor which caused her to leave the class. Her apparent adaptability and ability to see where the activities may fit for herself meant that she did remain in the class and engaged with the physical activities.

S4 had analysed the gender differences in the class and provided an important insight into what she saw as gender differences and her ability to function in this context. S4 did identify with the other female in the class and acknowledged the learning divide from one group of students in the class (the males) to the other. Rothschild (1988) has successfully argued that the concept of “integration or add women and stir” (p. 30) does not necessarily solve the duality of a Technology Education classroom. What is suggested is creating a gendered framework through a feminist mode of analysis of Technology which may address some of the remoteness that female students have traditionally felt within Technology Education (Rothschild, 1988). Murphy (2007) also highlighted the difference as to what students pay attention to and this reinforces the notions expressed by S4.

### 7.6.2.3 Summary

S4 noted the gender divide in her Technology class. She realised she was able to capitalise on the differences which she felt existed between male and female students in their ways of working in Technology Education.

### 7.6.3 Language use in classrooms

#### 7.6.3.1 Results

S4 was asked during the interview about her understanding of the terminology that was particular to Technology as a subject and used by the teacher.

_The teacher explains clearly what he means (S4)._
T4 did spend time explaining terms as he used terms at each step of the construction task. He drew diagrams on the cement and on the white board to show and explain what he was talking about. Rarely, during the observations, did S4 stop and ask for any clarification. At times she hesitated about what she was doing and would appear to think the problem through and then have a quick discussion with S5 before proceeding with the task.

7.6.3.2 Analysis

S4 did not appear to have an issue with understanding the terminology that was required for the construction tasks. She appeared to understand what was required especially in the later weeks of the project. Belenky et al. (1986) would argue that her immediate learning needs were being met and she did not need to question the instruction further. T4 did repeat what he said often and the students appeared to understand what he was explaining and demonstrating.

Paechter (1998) speaks of the revaluing of female voices. In arguing about power relations Paechter claims “they become inscribed in practices” (p. 8). Not stopping the teacher to question T4 or ask for clarification could be seen as the female student not wanting to challenge the superiority of the teacher as much as not wishing to stand out in front of the class.

In this instance there appeared to be a lack of female voice in the learning context. The difference in meeting with S4 away from the class context demonstrated her ability to not only articulate but also analyse and provide reflexive thinking. The practices of exercising a voice and questioning could be encouraged and in turn linked to discourses to provide the empowerment that this thesis argues for in female Technology students.

7.6.3.3 Summary

The use of terminology met the needs of S4 as an individual learner in the learning context. Learning the terminology in context is the key to functioning in Technology Education. The lack of use of the female voice can be attributed to teaching practices in the learning context and a lack of maturation of the students in the Technology department at that time of the year.

7.6.4 Motivation

7.6.4.1 Results

S4 reported that she had not initially chosen to undertake a Technology Education class but the Deputy Principal approached her about taking the Technology Education class. S4 saw the gaining of skills and problem solving as relevant to her choice of the subject. Learning the skills of problem solving and project management was more important to S4 than the idea of bolstering female student numbers for the deputy principal.
When S4 was asked about other STEM subjects, she pointed out that doing these other subjects provided opportunities. S4 did not expand on what opportunities when questioned further. She noted she had to do maths but did not do science but recognised the broader opportunities that were available for someone studying in those areas.

S4 was asked how she felt about the item the class was working on now. She listed the things they had done so far in the year. The class had made a saw-horse, constructed the wall framing, done bricklaying and painting. While she liked the wall project the painting was the most fun as she had never really done such an activity before. S4 saw this activity as ‘learning some life skills’. When asked where she could use these skills they [both the female students] said maybe at home. Neither student identified with, ‘I’m going to get a job’ or ‘use the skill as part of a job’ as a result of their learning in Technology.

The female students stayed close together as the teacher asked each pair to join with another pair. The two female students chose a pair of boys who were close by. While they were a group, they tended not to work together. Tasks were divided but there was little co-ordination within the group. However, this group did achieve a more accurate outcome than the second, all male group.

7.6.4.2 Analysis

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7.6.4.3 Summary

Working with others was a motivating factor which encouraged S4 to participate and achieve in the Technology class. For the most part this motivation came from the types of projects that the class was working on. Contribution to the community was important to the female students. The service provided in painting the church hall appealed to the social aspects of female’s ways of working (Belenky et al., 1986).

7.6.5 Role modelling and peer support

7.6.5.1 Results

Both of the students, S4 and S5, in this interview talked of the female teacher who was part of the Technology department the year prior to this study. The two female students knew of the all-girls class from the year before. Both were clear in their disappointment that the specific class was not run during this academic year.

On the second building day there was some friction between the females and the males which made the construction activity difficult during that lesson. The teacher resolved the issue by establishing tasks but the underlying issue made any co-ordination of the activity difficult. Not only was there a degree of unspoken tension from something external to the Technology class but it had the potential to affect the learning environment in technology. The lack of peer co-operation demonstrated that achievement could be limited because of other issues in the learning environment.

7.6.5.2 Analysis

Murphy (2007) highlights studies in which differences in how ‘boy’s and girls’ work have been noted. Females state a preference for working together and boys for working alone. “‘Girls’ are often the facilitators giving lots of support to others in discussing strengths and weaknesses in designs. Collaboration with peers provides students with alternative ways of seeing the world and thinking about it” (p. 249). Collaboration is often the result of negotiation of ideas after working groups have formed. To overcome the tension T4 continued with the task using his experience and teaching strategies to analyse some of the problem and put a strategy in place that allowed the activity to continue without jeopardy to any learners. The pairing of the students on a gender basis allowed the tasks to continue. The learning intention which Hattie (2009) refers to in his contribution of teaching approaches was not jeopardised because of the negative peer interactions that were occurring. T4 along with S4 accommodated the situation and adjusted their intended activities (Hattie, 2009).
The interactions of the students (male to male) in this class appeared to have an effect on the behaviour of the females. This was noted by T4 when he said, *the girls are quietly confident but they don’t push forward*. A Murri (cultural) trait is that they would tend to say less. This was a very different case once S4 participated in the interview. Her voice emerged and points came out that had not been discussed earlier in the unit. She had dutifully answered questions during the weeks of observation but never elaborated until she and S5 participated in the interview.

### 7.6.5.3 Summary

S4 did not report that she relied on her gendered peer to achieve in the Technology class nor that she was affected by peer interactions. She had a positive view of the class. Her outlook appeared to be a positive driver for her in this class despite some of the negative interactions which happened amongst the peer group during the observation period.

### 7.6.6 Socio-cultural approaches to learning

#### 7.6.6.1 Results

When asked would she recommend Technology studies to a friend, S4 nodded approvingly.

> *I would just tell them that it is good and the reasons. It’s not boring, like you get to do a lot of things like build a wall and learn a lot. It’s variety* (S4).

When asked how do they go about getting involved in projects

> *The teacher explains what they have to do and lets them [the class] do jobs around the school* (S4).

The sense of pride in the valuing of the projects that were being worked on was clear from this student. The females valued the input of the HOD (H3) and mentioned him in relation to the projects around the school.

#### 7.6.6.2 Analysis

Murphy (2006) argued that some females saw their identity in being technologically competent. S4 had a positive approach to the Technology construction class. This was reflected in her recommendation of the class to others. Her racial background appeared to make no difference to her willingness and ability to engage in the Technology class. As a teenage girl amongst a group of peers she was not willing to get anything wrong or bring about any personal criticism as a result of her action in the class.

The group organisation and achievements were consistent with what Petrina (2007) describes as Technology management. S4 was proud of the achievements of the group that she was a part of. These were the student group projects were part of their course. She also saw the
relevance of the service contribution and recognition of the HOD (H3) and other members of the school community gave to what the students were doing. She was a part of the school culture through her membership of this class. By her actions and participation she had a voice in making a contribution to the school and its environment.

7.6.6.3 Summary

S4’s participation provided a positive contribution to the socio-cultural milieu of the school community. It was the service and community aspects which added value to the school. The contributions added value to her personal place in the Technology class.

7.6.7 Values and Technology Education

7.6.7.1 Results

In terms of personal values and a future for herself from the Technology subject S4 could not articulate an answer. She said she was not sure, for the future but may want to do something like this (S4). She thought the bricklaying man was good as was the pay in doing a trade such as bricklaying.

In being questioned specifically about values in terms of her personal values or social values S4 relied on the physical aspect of the materials;

Some of the wood was, ‘more stronger’, than others (S4).

She shook her head when pressed about personal values replying; No I do not know (S4).

7.6.7.2 Analysis

S4 appeared to place no set of terminal or instrumental values such as those championed by Rokeach (1973) on her participation in the class. She did not appear to have a reason for taking the class except that it may be useful at some point. She did return to the worth of the project of painting the church hall. It was this project which solidified her reason for wanting to be in the class. Her comment about the pay of the tradesmen was something she had recalled from the bricklayer working with the class early in the year. There was a future notion of where Technology Education may lead students. She did not seem to personalise this for herself.

This student did not articulate what she meant about resources and their use in terms of environmental values and sustainability. There could be two factors at play. Firstly, it was not a concept she neither knew nor saw it as applying to what she was doing in this practical class. Secondly, there was a lack of analytical thinking which enabled her to look for answers in her experiences. Her lack of experience in Technology Education with resistant materials or properties of products stopped her from grappling with the idea of sustainability or long term
values. S4 did come up with the idea of wood and its properties however she did not believe this related to what she was being asked about values and how they may apply to her in the Technology class. Her final statement being: *I don’t know.* Dakers and De Vries (2009) argue with regard to perceptions and Technology Education that if a student has not been taught with a critical view then they are more likely to develop into adults who hold an uncritical and restricted view of the technology-mediated world they occupy.

### 7.6.7.3 Summary

By the end of the observation period (the second term of the school year) S4 had claimed a place in the Technology class for herself. She had a voice however she chose not to use it in the mixed sex setting of the class. Her opinions and beliefs and views were clear when she met with the researcher and her peer in the interview setting. Through all the themes which have been used to analyse the case study, excepting that of values, her views were clear and she was able to articulate them. It was some of these views which were at variance with T4’s views of what he thought the female students believed. This point enabled the researcher to revisit T4 and have a further discussion about the reported data.

### 7.6.8 Summary Student 4 (S4)

In terms of a learning ecology, S4 was settled and comfortable in the learning environment of the class. She felt supported within the Technology ecology. This was more evident towards the end of the period rather than earlier in the teaching year.

S4 had keenly noted the gender divide in her Technology class and realised she was able to capitalise on the differences which she felt existed between male and female students in their ways of working and thinking in Technology Education.

The use of terminology met the needs of S4 as an individual learner in the learning context. The learning strategies used by T4 assisted how all the students in the class learned. His repetition of terms enabled students to revisit the terms and clarify them. The master apprentice relationship was part of the teaching strategy and explanations of terms which the students readily accepted and worked on.

There was a motivating factor which encouraged S4 to participate and achieve in the class. For the most part this motivation came from the types of projects that the class was working on. The service that was provided in painting the church hall appealed to the social aspect of female learning styles.

S4 reported that she did not rely on her female peer to achieve in the Technology class nor that she was affected by peer interactions. She had a positive view of the mixed class which had existed and this appeared to be a positive driver for her in this class despite some of the negative interactions which happened amongst the peer group.
S4’s participation provided a positive contribution to the socio-cultural milieu of the school community. It was the service and community aspects which added value to the school. The knowledge that the Technology projects contributed to the school and added value to the community assured S4 of her personal place in the Technology class.

By the end of the observation period (the second term of the school year), S4 had claimed a place in the Technology class for herself. She had a voice however she chose not to use it in the mixed sex setting of the class. It was some of these views which were at variance with T4’s views of what he thought the female students believed provided them with agency.

### 7.7 Case Study 3 - Student 5 (S5)

S5 was a 16 year old female student who was friends with S4. S5 appeared to be quieter than student 4, and tended to follow the lead of S4 while in the Technology class. S5 was also an indigenous female student. S5 had studied DTA (Design Technology A) which was metal work in Year 8. She had not done any other Technology subjects until this class in Year 11. In the interview she had more in depth, reflective perspectives to offer.

#### 7.7.1 Learning ecology

**7.7.1.1 Results**

In talking about what elements made up the learning environment of the class, S5 did not think there was anything else that could be done to make the classes more inviting. She liked the individuality of the book work and the group work. What she liked about the class was their ability as individuals in the class to make a difference in the school community through the projects they were constructing. S5 liked the small numbers in the class and felt it made the working environment better.

When asked about the pedagogy and style of the teacher the response was:

> He’s a good teacher. He demonstrates for us and if we struggle he gives a hand (S5).

This statement flowed into S5’s views on the qualities of a good classroom;

> A good teacher, in a working environment where everyone has respect for each other through a teacher that’s dedicated. This is surrounded by learning in a subject area that you will use in the future and teach others (S5).

**7.7.1.2 Analysis**

In talking about the class, S5 covered many of the components of a learning environment outlined by Siemens (2006). She felt the class size was good and enabled the group to engage in the type of projects they did. She enjoyed the flexibility of individual and group work and the
availability of resources which enabled them to complete their tasks. Her comment about contributing to the school community is consistent with what S4 reported and the research studies of Belenky et al. (1986) and Murphy (2007).

The female students, especially S5, had not spoken very much in all the researcher visits to the practical Technology class. It was difficult to interview the students during the workshop lessons due to the open air nature of the space and the loud machines that the class were using. The willingness of the girls to talk openly in this setting was positive and their views well thought out.

7.7.1.3 Summary

The positive views expressed about elements of the learning environment were factors which made the Technology class ‘special and unique’ for S5. She did not speak of particular interactions but rather parts of project which she was involved in and how she had interacted in that learning event, singularly or as part of a group.

7.7.2 Gender and Technology Education

7.7.2.1 Results

The Deputy Principal had approached S5 about taking this Technology class just as she had with S4. S5 said she saw it as,

\[\text{A potential for a future that could be in the construction area (S5).}\]

Students should, according to S5:

\[\text{Engage in STEM for careers or what you want to be when you’re older. Science is optional but important (S5).}\]

In terms of jobs, she saw Technology as more of a ‘man’s job’ but could not verbalise why more girls did not do the subject.

S5 did not see any gender issues that related to her. When asked would she prefer a male or female teacher, she replied, ‘\textit{a boy’}. When asked why, she shrugged and just said she did not know why.

In discussing who S5 would prefer to work with in building and construction, her reply was she would prefer a random selection of people, not only the females as was the case in the classes that the researcher had observed.

When asked about the teacher expectations of the female students she firstly said she did not know but on thinking further said,

\[\text{We’re capable to do what the boys do. We make the standard level (S5).}\]
Chapter 7. Case Study 3

7.7.2.2 Analysis

The Deputy Principal who was responsible for timetabling appeared to be the administrative person who was instrumental in encouraging S5 and her peer S4 into the Technology class. T4 had discussed the schools decision to collapse the female Technology class which had run the previous year. T4 also noted that the Technology construction class was timetabled against hairdressing and that other female students were taken from the class into Science engineering. Dakers (2007) cites frequent occurrences where this is done in schools. Was it a case of the Deputy Principal ensuring that there were some female students or had she taken away the high achieving students and left the female trades and those a little uncertain what they wished to do?

S5’s reporting of Technology as a man’s job would not appear to give herself a long term view of why she was undertaking the class or engaging with the activities. Her lack of explanation as to where she saw Technology taking her did not help clarify the view she had expressed. It did, however reinforce the male oriented nature of how she saw the activities and the department in the school. Murphy (2009) argues that if Technology and its associated discourse were less gendered then females would see the point in taking on the challenges and creating their identities in relation to the learning area. Whilst this was European research, very little progress has been made in other countries, or since 2007.

Dakers (2007) argues that such a course is delivered by males in a hegemonic male setting in a relatively archaic manual arts tradition of master servant, trades and apprentice style leaves little room for alternative gender discussions. Keeping the status quo and not exposing the issue would be seen as a positive (Barlex, 2007). A number of issues emerge from S5’s statement that there were no gender issues related to her. It appeared not to be a topic that was explored in relation to herself and Technology.

S5 reported that she would prefer to work with a random selection of people. The impression was that at times the two female students felt somewhat ‘lumped together’ and locked into that scenario rather than being allowed to be independent risk takers. In exploring the difference of learning styles between males and females, Rasinen, Ikonen and Rissanen (2006, p. 58) would argue that “historically for Finland there is a long held myth of girls jobs and boy’s jobs”, however changing the curricular has made little to no influence on bringing female students into Technology Studies in secondary schools.

If one followed the Rasinen et al. (2006) argument to accommodate female thinking and the role of aesthetics, this could change the nature of learning in technology. S5 was unable to articulate her views on gender issues when asked to reflect on the teachers expectations of the females as against the males. The positive response she gave was that she was capable and could reach a standard level of skill. She had demonstrated how much growth and development in her own self-concept since the first observation day in the bricklaying workshop. The staff of
the school valued and recognised the female student’s contribution to projects however they continued to see the projects as non-gendered (see T4).

### 7.7.2.3 Summary

S5, like S4, had a place but not a voice in the class. She chose not to exercise her voice. S5 had developed as a student in this practical Technology environment. It was a male environment and there could be little room for growth in terms of understanding the need for addressing gender so the females could better interact in the learning community.

### 7.7.3 Language use in classrooms

#### 7.7.3.1 Results

For the most part, S5 did not notice any language use that was different for her or S4 to that used for all of the students in the class.

S5 mentioned the technical terms which were used during the projects. She said T4 was careful about explaining them to all the students. T4 would then do a check in as he circulated the project stages to see that the students did understand what the trade terms were that he was using.

#### 7.7.3.2 Analysis

Talbot’s (2010) argument about default language is firmly evident in this situation. While S5 did not notice any language differences in the Technology class, there were a number of times when T4 said, **guys**, to get everyone’s attention and then as an afterthought added; **and ladies** (T4). It was difficult to know if this was a usual addition to his words or if the additional dialogue was because the observer was present. T4 did say at one point;

*The language may be different if you [the researcher] were not here* (T4).

Any technical terms were explained and revisited in response to student needs and questions. The language of the environment was one of a workplace with trade terms being used. Talbot (2010) would argue that the language discourse in this instant was one of social reproduction. Feminist studies, as argued by Talbot (2010, p. 118) suggest that, “the conventions of the words and ways of doing as a result of the discourse serve to reinforce the identity of the culture in which it is used”. S5 did not notice the terminology.

#### 7.7.3.3 Summary

In this site there was little emphasis on language apart from the technical work related jargon which was imparted by T4 to his students. S5 quickly learned and adapted to the language and discourse in order to function in this setting.
7.7.4 Motivation

7.7.4.1 Results

S5 explained about the painting of the church hall that was the introduction to the practical part of the course. To her this activity and making the saw horse were the most fun. The painting was because it was for the church.

Photos were taken of the job (S5).

7.7.4.2 Analysis

Pintrich and Schunk (2002) argue that motivation is the process whereby goal directed activity is instigated and sustained. As such, the process involves goals that provide the impetus for and direction to action. In the case of S5, one could ask was the activity (the painting) the motivation or the cognitive actions of planning, solving the problems of setting up the task, making decisions and assessing the progress, the motivating factors? The final motivational factor was instigating the task and sustaining it.

7.7.4.3 Summary

This activity was one that was noted and valued by S5 as distinct from T4 who barely recalled the activity. T4 had not used the activity as a motivational driver for engagement in the course. Its importance as an engagement and learning strategy for the female learners was undervalued.

7.7.5 Role modelling and peer support

7.7.5.1 Results

The only discussion on this topic was the reference to the female Technology teacher by S4 and S5 nodding in agreement that they knew the teacher was in the department in the previous year. S5 appeared loyal to their present teacher and felt that he was an adequate role model.

S5 wanted to be part of different groups in the class and stated that she would prefer random assignment of groups ahead of working with a friend (the other female). This was not what was observed by the teacher or researcher. The females appeared to rely on one another, worked closely and looked for support frequently. That support was provided by the teacher rather than other students. T4 would ask a question of S4 and at times it went unanswered. On several occasions S5 knew the answer and verbalised it to the immediate group but she would not answer in front of the class.
7.7.5.2 Analysis

Dakers (2007) argument around peer support did not appear consistent or important to S5 around the presence or absence of a female Technology teacher. Her focus was on the present teacher’s support and her own individual ability to work as a member of the class.

S5 to a greater extent than S4 wanted to not have to choose to work with specific people nor singularly with S4. This was not due to a dislike or competitive notion with S4 but rather the wish to learn from others and interact with other people in the Technology class. The issue appeared to be that S5 felt that perhaps she could work differently if provided with more independence in the work environment of the class. Murphy (2007) argued that she was empowered to take some control of her learning. The teacher’s role of assigning work partners meant the females were not seen as seeking male groups. They could gain some collegiality in this work environment. There would be no social stigma on a random assignment compared to students ‘picking groups’ or choosing who they wished to work with.

7.7.5.3 Summary

S5 felt supported in respect to the modelling capacity of T4, however, she wished to gain more peer support through working at different times with other members of the class to learn different skills and work habits.

7.7.6 Socio-cultural approaches to learning

7.7.6.1 Results

S5 saw the importance of the class for her in learning how to build (construct artefacts). She liked the variable nature of what they did in the program and believed that it was working both as an individual and as a group that was important. If the teacher is away there is always an unfinished saw horse to go back to and work on.

Student 5 spoke of her wish to be ‘assigned random groups’ in order to work with others, but also work in an environment that was ‘secure, structured, well and safe’. In her words,

You don’t know what you’ll do in the future. The bricklaying man was straight up – he told you how it is (S5).

The message which S5 had taken from the bricklaying teacher was that it was not a socially appropriate job for females. She was able to repeat his words two terms later. He had made a socio-technical impact on these learners.
7.7.6.2 Analysis

S5 recognised the relevance of learning in Technology Education, for a possible future for herself. She knew that the practical nature of the activities could be applied in other contexts and that there was some room to make decisions within the teaching program.

S5 talked of her part in the class and the support of the teacher but rarely of peer support or relating to the class as a whole or as an entity. When the concept of the class arose she was generally referring to a finished project which they had all participated in for the benefit of the school community. The lack of personal identity with the projects can be seen as a marker of the social shaping of technology. Wajcman (2004) says that whilst the Technology is made into a physical object during production, the symbolic meaning is not necessary one that S5 would identify with. Wajcman argues that the control of the making and the ultimate consumption is the dividing line between the gender identification (2004). In this case, the disenfranchisement of the object to the student is supported by this argument. There was little self-expression in the decision making or the object that related to the female students.

The socio-technical impact which the bricklaying teacher had made on S5 was not positive in terms of portraying firstly what is appropriate or possible for females to engage in and secondly what tasks are portrayed as in his gendered discourse. Using the terminology of Wajcman (2004), he had ‘gendered’ a Technology process that was already tainted with masculine overtones.

7.7.6.3 Summary

There was a need for an identity within the class and with the class that was lacking according to S5. The bricklayer did not incorporate a positive attitude as to what females could achieve in his trade area and the notion he had expressed during his workshop day had remained with the female students. S5 wanted opportunities and to be able to apply her learning to her reality both now and in the future.

7.7.7 Values in Technology Education

7.7.7.1 Results

S5 saw opportunities in the field of Technology Education for herself as a possible future, but also in the potential of recommending the course to peers. She was well aware of construction opportunities and the breadth of jobs that could be undertaken as well as the ability to,

Build your own stuff, and that may also include houses (S5).

On the question of values S5 said values, was not something she had thought about.
7.7.7.2 Analysis

S5 recognised the long term values which could apply to her undertaking this practical Technology Education class. She appeared to have the ability to see the much broader implications and applications of what she was engaged in. She could articulate some longer term aspirations but did not hold clear terminal values as expressed by Rokeach (1973) and Pavlova (2009b).

The reaction of S5 when asked about values was the same as that of S4. She had not thought about the term ‘values’, and could not explain the concept. This is consistent with T4 reporting that ‘it was not something they talk about’. Pavlova (2009b) argues that it is a concept which must be taught and discussed in order that students can understand and apply it in context.

7.7.7.3 Summary

There appeared to be very little understanding of the term values from S5. There was less understanding of the term in relation to conservation of wood or sustainability compared to the discussion with S4. This was a result of the terms not being taught or discussed in the context of Technology Education.

7.7.8 Summary Student (S5)

The positive views expressed about elements of the learning environment were factors which made the Technology class ‘special and unique’ for S5. She explained parts of projects which she was involved in and how she had interacted in that learning event, both singularly or in a group.

S5 had developed as a student in this practical Technology environment. She had a place in the class, but chose not to exercise her voice. It was a male environment and there could be little room for growth in terms of understanding the need for gender to be addressed in terms of how the females could better interact in the learning community.

In this site, there was little emphasis on language apart from the technical work related jargon which was imparted by T4 to his students. S5 quickly learned and adapted to the language and discourse in order to function in this setting.

The motivational aspect of working on the church hall was important to S5. This activity was one that was noted and valued by S5 as distinct from T4 who barely recalled the activity. T4 had not used the activity as a motivational driver for engagement in the course. This part of the hidden curriculum in terms of relevance for learning is where gendered aspects can throw the spotlight onto what is important for a diverse range of students.
S5 felt supported in respect to the role-modelling capacity of T4, however she wished to gain more peer support through working at different times with other male members of the class. As a teen she did not want this to be a free choice but rather a directed activity by T4.

Socio-cultural aspects of the program did not provide an identity for the class participants. According to S5 they were not branded with some of the positives which the class could and did achieve and contribute to the school. The bricklayer did not impart a positive attitude as to what females could achieve in his trade area and the notion remained with the female students. This student wanted to be able to apply her learning to her reality both now and in the future.

With respect to values, there appeared to be very little understanding of the term values from S5. This was a result of the terms not being taught or discussed in the context of Technology Education.

7.7.8.1 Emerging findings

A positive learning environment made a difference to the female students and their willingness to engage in this case study. Feelings of support and the notion of feeling special and unique appeared to enhance the engagement of the female students. One particular service project which engaged the female learners was the second factor that which allowed them to identify with community in terms of the project they undertook made a difference. In this setting there was no sense of a cohesive class as decisions centred on the teacher rather than shared between students. This factor within the learning ecology suited the female students and allowed them to find their place when first coming to the Technology class.

The HOD’s expression that it’s everyone’s business to own equity issue is important for Technology Education. Equity in respect of gender was about giving equal opportunities for females to participate in Technology as much as other trade based courses. Recognition of gender specifics provided confidence for the female students to work on artefacts in Technology and gain a sense of expertise with regard to the tools and having a place in the workshops. The continuation of a master-apprentice relationship between the teacher and all the students did not allow the students to become empowered learners with the freedom to make decisions and experiment. It did ensure success with projects. There was a need to recognise a curriculum that allowed for a social community contribution from the projects the students were engaging in.

Male staff members did not see language as an issue that needed to be altered. The prevailing masculinity of the department will continue this use of terminology with respect to ownership of language related to technology. Learning the technical jargon was a factor to enabling the female participants to function within the learning context.

The lack of voice of the female students appeared to stifle their motivation to perform in the workshops. They did not willingly step forward to provide solutions to problems posed
The female students did exercise a presence and were able to lead in some of the making activities. There was motivation to participate and achieve in the class. Motivation appeared to stem from the types of projects undertaken. The contribution of the tasks to the school and its community was the driver to achieve within the class. The difference between the teacher’s view of the values of some of these tasks and the female students illustrated the need for a pedagogy that took account of female learners and their motivations.

The students were happy to take their role modelling from male teachers and peers. The female Technology teacher who had been in the school was still casting a positive model on the students. To entice future female students into the Technology department more needs to be done in terms of having the current females seen as role models to younger students. Recruiting more female teachers or aids would be the second positive outcome.

The socio-cultural needs of female students should take precedence over trade training if more females are going to engage in Technology Education. Trade skills may be relevant in the working class area where the school is located but to date it has not been an inducement for female learners. The trade focus mixed with gendered male dominated language has shown that females will opt out rather than into these courses. The female students aim for quality work, done with precision will impose a time factor on schools. This was opposite to how the male students operate, quick and fast. The quote by the HOD, they are doing a good job, rather than a big job (H3), is evident in the work the two groups undertook.

Overcoming traditional domestic cultural views of the role of males and females and their future work roles remains a hurdle in this setting reinforced by the ‘industrial’ nature of what the Technology department seemed to be promoting. The female students saw the worth of their contribution to the community through projects such as painting the church hall. The females saw the socio aspects of the class, executed through the skills they learned, as the most important thing they could learn. The applicability for them now and in the future made a difference. The white Anglo-Saxon teaching and programming reinforced the social stereotyping of Technology Education to the detriment of future female learners.

Finally, the concept of values was recognised by the female students as relevant in terms of what they could learn and apply from this study but there was no depth of understanding of the social aspect of the term. Short term immediate values with respect to pride in completing a job that was valued by the community did make a difference to the female students. Sustainability and recyclability were not factors which made a difference to students. Where H3 saw the recycling materials bin as an opportunity, students saw it as waste.
7.8 Conclusion

From the institution’s point of view, the process of learning skills for trades was the product they were producing rather than any artefacts that the students made. The focus suited the location of the school in its community and the vocational outcomes were structured for a working class clientele. The skills base focus should not be limited to the type of student who cannot achieve in other areas of learning. This sentiment was echoed by the female students, the teacher and the HOD. There did not appear to be any plans to change the status quo.

The following chapter is Chapter 8 which provides the concluding chapter to this thesis. This chapter provides a discussion of the findings from each of the case study chapters.
Chapter 8
Conclusion

This thesis investigated female student participation in Technology Education at the senior high school level. The research study examined the classroom environments in school settings to identify measures that could be undertaken to increase the participation of female students in Technology Education. The thesis examined the strategies and principles that underpinned effective classroom environments in order to identify those factors that would meaningfully encourage the engagement of female students in Technology Education classrooms and, as a consequence, increase the participation rates in the long term.

Three research questions were investigated, what factors have influenced female student’s choices to take Technology Education classes as part of their senior school pathways? The investigation was undertaken through an examination of the social construction of realities from the individual and the collective group point of view, drawing on theories of women’s ways of knowing by Belenky et al. (1986). The second research question asked - how teaching and learning was conducted and approached in selected Technology Education classrooms? The third and final question asked - what values were addressed in the teaching and learning in Technology Education classes?

The thesis examined whether or not the recognition of an active progressive social construction of gender could alter the teaching practices through changing the content of Technology Education in the light of an awareness of gender engagement in the Technology learning area. It was timely to do this with respect to Australian national developments in Technology Education and the launch of the Australian curriculum documents in Technologies.

The first reason to undertake this research was that the issue of gender in Technology Education has been under researched in Australia. The exploration of the construction of gender in relation to Technology Education it has been done in the context of contemporary Australian society. Considerable time has been devoted by UNESCO to the encouragement of girls to become involved in not only education but specifically, in Technology Education.

The second reason for this research was the emancipatory potential that Habermas (1971) claims can “free individuals from existing forms of cultural domination”, (p. 69), such as male operations and language in Technology Education classrooms. Habermas argued that the only knowledge that can truly orient action is knowledge that frees itself from human interest and takes on a ‘theoretical attitude’. Theoretical attitude is one that recognises the sources and consequences of the power of ideology and language in producing what we call truth.

The chapter is structured in the following way. The theory which underpins the thesis and the research study is summarised. Then, the research question and the sub-questions are
noted. Subsequently, a summary of the findings from Case Studies 1, 2 and 3 is then presented. This is followed by an outline of the contribution of the study to knowledge and practice in relation to the engagement of females in Technology Education. Finally, suggestions are made for further research.

8.1 The theory underpinning the thesis

The following outlines the theoretical framework which underpinned the research problem of engaging more females in Technology Education. A socio-cultural approach was the framework for this study. As an epistemological framework, it provides a platform for the socio-constructionist belief that knowledge is formed and transformed within specific contexts, shaped and expressed through different forms of media, and processed in different people's minds. It is about the dynamics of change (Ackermann, 1992).

The literature review provided an analysis of research examining gender in education and females and technology, language and more recent STEM developments. The literature review established that little in-depth research exists on gender and the language discourse which stems from Technology Education classrooms, and even less exists in relation to the Australian context.

The social constructionist feminist theory of Bijker, Hughes and Pinch (1987) acknowledge that power relationships can benefit one group and not another. Social constructionism stems from gender assignment prescribed at birth. Paechter (1998) argues that whilst gender is usually ascribed to babies at birth, our assumptions about a child’s future are more to do with social and cultural values than with body features. Paechter goes on to argue that much of what Western Society takes for granted as ‘natural’ with respect to sex and gender is socially constructed and androcentric, that is, seen from a male point of view and prioritising the male gender. The Smith and Lloyd study (Paechter, 1998) illustrated the weight of gender assignment by parents to children from the time of infancy. The social stereotyping provides gender roles and, as Talbot (2010, p. 125) “says, we are shaped by the discourses and resultant gender performances”.

Feminist theory in this sense can be seen an ideology as much as a methodology which makes inequalities obvious (Willis, Thompson, & Sadera, 1999). In the past, feminist theory has not been seen to produce positivist results, however, Willis, Thompson, and Sadera have developed positive results related to teachers as reflective practitioners (1999). As teachers reflect and discuss issues of gender difference and engagement, the discussion and realisation may bring about a change to practice through a reduction of marginalisation. Hesse-Biber (2013, p. 10) examined different types of feminist research and theoretical traditional around women’s issues as a lens through which to view social issues. The quest to arrive at new
epistemology (ways of knowing) and methodologies (ways of asking) built on the knowledge of
positivist feminist research through paying closer attention to women’s individual lived
experiences. The theory mixes research with practice to examine difference. “It is not sufficient
to acknowledge difference. Difference needs to be incorporated into our views of reality, truth,
and knowledge” (Hesse-Biber, 2013). We need to look to the difference that difference makes.

The focus of this thesis was on females who are identified as the culture-sharing group -
the subject of this study. Culture, by definition, covers all human behaviour and beliefs and
includes the study of language, rituals, structures, life stages, interactions and communication.
The study described and then analysed the culture-sharing groups and interpreted patterns
within the context of culture-at-work.

The feminist ethnographic case study underpinning has allowed for the examination of
behaviour, beliefs, language and how shared patterns of interacting in the educational settings
were used in the research. The research approach involved reflection with a view to
transforming the social setting of the Technology Education classrooms. This research aimed to
contribute to academic discourse through engaging in active reform processes, encouraging
practico-reflective awareness and theoretico-reflective awareness. By people being willing to
put their own truth claims into the research conversations then as Carspecken (1996) reminds
us, morally social research will either hurt or help people: it rarely has purely neutral effects
with respect to human welfare. Making the research project as democratic as possible, and as
transparent as possible from start to finish, is the best way to help rather than harm (Carspecken,
1996). Thomas (1993) argues that insights gained through an ethnography find differences in
the views of the researcher, the subject and from these insights the study may change. Such a
study is a dual transaction process for the subjects, the scientific nature of research and for the
audience.

The third area, which this study was mindful of, was the type of critique used by
feminist writers. Critiques are different. All critiques seek to unmask social issues writers of the
radical and the Marxian schools seek to investigate from a negative or subjective point of view
(Wajcman, 2004). Such a view that says all women are oppressed and hence in need of some
rescue. This study, however, took a positive perspective in unearthing the voices of females in
Technology Education through a modern socio-cultural liberal feminist perspective.

The socio-cultural liberal feminist perspective addresses the second of the research
questions. Socio-cultural approaches to learning provide instruction which recognize and
empower linguistically and culturally diverse students. Socio-cultural theory describes learning
as distributed, interactive, and contextual and the result of a learner’s participation in a
community of practice. The collaboration of thinking that results from these processes opens up
access to direct data on thought processes and provides avenues to uncover distinguishing
characteristics while recognizing the interdependence of concepts.
The research was informed by socio-constructivist and social constructionist theories. More specifically, the concept of the Social Construction of Technology (SCOT) by Bijker, Hughes and Pinch (1987) was applied in the analysis phases. The socio-constructivism framework provided a vehicle for the exploration of social constructivism as a critically and politically engaged set of views on knowledge and science which provides a more applied model than does the constructivist approach with its broader set of views on the nature of knowledge and cognition (Smith, 2006).

Socio constructivism is an open ended process where knowledge is constructed through the interplay of existing knowledge and the individuals’ social experience. It is an individual theory. It has been used in relation to pedagogic strategies and instructional design models which as a learning theory emphasizes the impact of collaboration, and negotiation on thinking and learning. Society plays a developmental role for the individual and the teacher acts as the scaffold of learning (Johnson, 2002; Vygotsky, 1978). This is distinct from the Piagetian view that individual knowledge relies on the social construction of it (Doise & Mugny, 1984; Piaget, 1995). Learning is a communication process via the interactions an individual has with those around them. Learning designs should be about local collaboration and the interactions to learn lie with the domain experts. Collaboration is the key in the learning process.

Bijker (1995) argues that there is a process of closure and reflection on technical change and stability. Over time, everything can fit into a technological frame comprising of knowledge, goals, and values as well as artefacts. Learning within a techno-social sphere may be the best environment for females (Bijker, 1995).

Social constructionism stemming from the Vygotskian notion of activity theory is a social phenomenon (John-Steiner & Holbrook, 1996). It is a social concept, a practice that is the construct of a particular group. The social construction of reality which stems from humans as social beings is an ongoing and dynamic process where people act on their interpretation and knowledge of reality. Social constructs are not those given by nature but ones that must be constantly maintained and re-affirmed in order for them to persist. The origin of social constructionism in the post-modernist movement says that gender is socially constructed. Gender, as a construct, is not created by nature as a result of biology but rather created by and contingent on social and historical processes (Oldenziel, 2003; Restivo & Croissant, 2007; Stanley, 1993; Vygotsky, 1986).

Wright (1992) suggested that Technology educators need to look for other ways to conceptualize their subject matter to reach the diversity of students who are now in our schools. Technology educators must rethink the way in which they legitimize the knowledge of Technology Education for students in order to meet their needs and wants. Wright stated that the social commitment must legitimate the principle of difference, to encourage and multiply different kinds of people and positions and values for their own sake, within the bounds of
“It is through the legitimacy of difference that new and necessary forms of rationality will emerge” (p. 212).

As with postmodernist theories such as Wright's (1992), feminist theories encourage diversity in their view. Feminist theories, like other forms of postmodernism, encourage us to tolerate and interpret ambivalence, ambiguity, and multiplicity as well as to expose the roots of our needs for imposing order and structure no matter how arbitrary and oppressive these needs may be. As Flax (1990) indicates, “If we do our work well, reality will appear even more unstable, complex, and disorderly than it does now” (p. 183). Both postmodern and feminist theories point to diversity as a direction for the future and can provide some of the ideology for Technology educators’ avoiding a restricted cultural view and creating change in the profession (Zuga, 1996).

The research of Zuga (1996) and Wajcman (2004) has examined the stigma of artefacts and highlighted the sociotechnical constructivist approaches born of, but modified from social studies of technology. It was the characterisation of Wajcman’s ‘techno-feminist’ which represented a major development in theorising the gendered character of technology. “Cyber-feminists were coined as a cultural term in social theory by Haraway in a quest to expose the gender blindness of main stream techno-science studies in order to show the possibilities this area offers women and how they could strategically engage” (Wajcman, 2004, pp. 106-107).

In summarising the theoretical underpinning of this study, the approach adopted was to examine the constructs of gender and the feminist issues around the construction of ideas as they applied to classroom practice in Technology Education studies. Gender in this interpretation, is a constitutive social construction, a social category whose definition makes reference to broad network of social relations, not anatomical differences (Durack, 1997; Haslanger, 1995). The application of gender in Technology Education classrooms is dependent on the relationships and interactions in context of where female students learn.

**8.2 Research question**

The research question examined in this study was – what are the factors that encourage and facilitate female students to participate and engage in design and Technology learning activities in Technology Education classrooms?

The three research questions explored were:

- What is unique about the ecology of classrooms that facilitate female participation? That is, how is teaching and learning conducted in relation to female participants.
What are the socio-cultural approaches to learning that shape a model of enablement for females in Technology Education?

What values shape the engagement of female students in Technology Education?

8.3 Summary of findings from Case Studies 1, 2 and 3

Overall, the thesis found that the impact of curriculum on Technology students has an influence on what female students choose to study. Student backgrounds in terms of socio-economic status largely influence what they choose to study within school settings. Life experiences and vocational aspirations of students contribute to female students’ study plans. Having knowledge of the benefits of the subject area, the development of thinking and, hands-on skills and the advantages which the learning may afford participants appears to make a positive difference to females. These are the values orientations.

A female-oriented pedagogy that meets mixed learning styles with structure but provided individuals with the independence to problem solve and discuss issues appears to be an undervalued aspect of Technology Education. The worth of the output and its social value is part of the criteria that female students use to judge the relevance of the Technology Education courses. Broadening the information base about Technology Education will expand its appeal to potential female participants. This is an area for further study.

Lastly, gender support and role modelling is the factor which appeared to afford a sense of well-being to female students and provided some security of their place when the female students commenced study in a Technology class. Increasing female participation would appear to involve a combination of curriculum content, pedagogy and cognitive challenges in a safe and supportive environment. The importance of relationships and acknowledging difference was the key to the plurality of the approach that gained more female participation in Technology Education.

The findings from each of the case studies are outlined below in summary form.

8.3.1 Case Study 1

Learning within a techno-social sphere where there are positive social interactions may be the best environment for females. Bijker (1995) claims that there is a process of closure, reflecting on aspects of technical change and stability over time which shows that everything can fit into a technological frame comprising of knowledge, goals, and values as well as artefacts.

The first finding from Case Study 1 was that building on the social, creative and cognitive aspects was important in developing confidence with female students who were moving into what was initially, an unfamiliar environment. These findings are consistent with those of Hawley (1986) and Tembone (2008) who argue that the ecology of learning in Technology Education classes must embody the pedagogical strategies that incorporate more
females. Providing a structure which the female learners could identify with and be guided by, was found to enable female students to become self-directed learners, gaining confidence to engage in the Technology process, realise a design and transform it into an artefact.

Finding two was that teachers believed they engaged with a gender neutral curriculum. However, this was not supported by classroom observations, which found that projects were not gender specific or electively individually chosen. Young female learners voiced their dissatisfaction at certain templates they were given to work with.

Finding three was that there was an awareness of the need to teach higher order thinking concepts and project management. These areas were ones where the female students excelled and would as such attract more female participants over time.

Finding four was the importance of students knowing where the subject may take them. That is, what future options Technology Education courses provide in terms of university and other formal courses, trades and life skills. These were found to be relevant when female students made subject selections. It should follow that a broadening of information around Technology Education within the school community may increase female acceptance of the subject and in turn the intake.

Employing female teachers as role models and utilising peer groups appeared to be critical to female student engagement. In addition, teachers who demonstrated understanding of individual student learning needs whether they were male or female appeared to be able to stimulate positive appeal in the study area for female students.

This case study found that students, in limited numbers to date, could overcome the historic stereotypes if they are motivated to achieve in the subject area. Those females who did participate in the senior school courses achieved high level results once they found their place in the class and learned the discourse and skills required for the subject.

Finally, the study did not find that there was an acute awareness of values and sustainability or a social consciousness around the issues of learning for sustainability or for conservation or recyclability. This was a potential source of knowledge and practicality which female students could have related to and identified with in this case study.

The following presents a summary of the findings from Case Study 2.

**Case Study 2**

In examining gender and Technology Education in Case Study 2, several findings emerged. The first was that female students began the courses with a perceived and actual lack of relevant skills. These skills related to the technical language as much as the practical hand skills that may be required in artefact construction.
The second finding was that their superior ability to plan, manage and organise projects meant the outcomes that female students achieved often surpassed those of the male students. Time and resources were efficiently managed and projects were finished ahead of male students.

The third finding was that the recruitment of female teachers for Technology provided positive agency for the female students. This is consistent with Siemens (2003) argument that learning environments mixed with positive gender messages in Technology Education will promote female participation. Brown, Collins, and Duguid (1989) argue it is diversity which encourages female learners to self-organise as a characteristic of their learning style that promotes learning communities. It is these aspects which attract female participants.

Case Study 2 suggested that there was non-gendered language in use in Technology Education classrooms. This is contrary to research from a feminist perspective that argues that the default language is always to the male accepted and understood terminology with its inherent social norms (Talbot, 2010). The reason for the contrary finding appeared to be that adjustments were made for female students, particularly in terms of explaining technical terms early in the course. As the female students felt comfortable within the learning environment they actively engaged in becoming familiar with specific technical terms through discourses conducted at the workbenches. In finding their own identities in the workshops the female students engaged and participated in the banter of the workshops.

Techniques used by skilled teachers in Case Study 2 motivated students in their classes. Of specific appeal to the female students was the pedagogy which provided a structured program that encouraged learning styles which female learner’s best engaged with. Clear scaffolding provided problem solving avenues from which flowed project management skills and planning that the female learners excelled in. The apparent freedom to learn within what was a sophisticated structured environment did motivate the female students to excel. This is consistent with Hattie’s (2009) claims that student motivation is at its highest when students are competent, have sufficient autonomy, get feedback, set meaningful goals and are affirmed by others. Females will take on internal motivational factors ahead of males who will externalise their academic achievements (Hattie, 2009).

Role modelling and peer support were factors which were reported, and observed as having positively influenced the female Technology students. The sharing of workshop space with students in Year 12 and female staff members being present was noted by the participants as important. Pintrich and Schunk (2002) whilst focussing on motivation note the importance of role modelling and peer groups for teens. Female students did not identify with needing female teachers; however, they did acknowledge that having a female presence in the Technology department provided encouragement and a voice for them as students.

Peer relationships were seen as more important than same sex groups for the learners in Case Study 2. It was the extra-curricular mixed senior classes and the social support of other
females that was identified as important for the encouragement of the female learners during the learning observations.

Teachers across the research study, but, specifically Case Study 2, identified differences in learning approaches from male to female learners. Recognition was in different learning patterns, modes of interaction in the workshops and social interactions in unfamiliar environments. This is consistent with the arguments of Belenky et. al., (1986) who highlight the notion of connected teaching and a feminine method of learning and thinking which is public and not private in dialogue.

Staff members in this case study expressed the belief that students could and would achieve because of their identification with activities that advanced the collective good of the student cohort. In this site there was a greater shared support and responsibility from within the peer learning groups. The high expectations from the school were reinforced by families and in turn they supported the future expectations for the female learners in areas related to technology.

Gendered power relations were evident in this case study between teachers and female learners. This was despite the progressive nature of staff engagement with female learners. Talbot (2010, p. 121), argues that “until more of the positions of power alter from the traditional gendered practices that are endemic of trade workshops of days gone by then we cannot fully embrace communities of practice” that will entice more female learners into Technology Education workshops.

The final finding in Case Study 2 was concerned with values in Technology Education (Pavlova, 2009b). This includes the concepts of functionality, sustainability and life skills. There was an acknowledgement of the functionality of values for participation and empowerment in respect to intrinsic motivation for career purposes and the immediate learning needs of the female participants in Case Study 2. Staff acknowledged that while they viewed the notion of values as implicit, they may need to revisit it in terms of senior school learners in their classes. The students, both male and female did not own or identify with a concept of values. Staff saw the need to revisit the concept of values as it related to sustainability and self.

The following presents a summary of the findings of Case Study 3.

**8.3.3 Case Study 3**

The first finding in Case Study 3 was that positive learning environments made a positive difference to the female students and their willingness to engage in Technology Education learning. Feelings of support and the notion of feeling special and unique appeared to enhance the engagement of female students.

The second finding was around engaging females in activities they identified with. One particular service project which engaged the female learners was the second factor which
allowed the students to identify with community in terms of the project they undertook. The female students noted that this project made a difference by way of engagement in the course and the contribution to community that they had to offer. In this case study there was no sense of a cohesive class as decisions centred on the teacher rather than decision making being a result of shared dialogue between staff and students or students and students. This factor, within the learning ecology, suited the female students and allowed them to find their place when first coming to the Technology class.

The third finding related to the staff view of equity. The HOD’s expression that, *it’s everyone’s business to own the equity issue*, is important for Technology Education. Equity in respect of gender was about giving equal opportunities for females to participate in Technology as much as other workshop based courses. Recognition of gender specific requirements provided confidence for the female students to work on artefacts in Technology and gain a sense of expertise with regard to the tools and then having the students find a place in the workshops. The continuation of a master apprentice relationship between the teacher and all the students did not allow the students in Case Study 3 to become empowered learners with the freedom to make decisions and experiment. It did ensure the successful outcomes of projects.

Male staff members did not see language within Technology as an issue that needed to be addressed or altered. The prevailing masculinity of the department will continue its use of terminology with respect to ownership of language related to technology. Learning the technical jargon was a key factor to enabling the female participants to function within the learning context.

The lack of voice of the female students in Case Study 3 appeared to stifle their motivation to perform in the workshops. The female students did not willingly step forward to provide solutions to problems posed despite knowing the answers. The female students did exercise a presence and were able to lead in some of the making activities. There was motivation to participate and achieve in the class. Motivation appeared to stem from the types of projects undertaken. The contribution of the tasks to the school and its community was the driver to achieve within the class. The difference between the teacher’s view of the tasks and how the female students valued some of the activities illustrated the need for a pedagogy that took account of female learners and their motivations.

The students were happy to take their role modelling from male teachers and peers. The female Technology teacher who had been in the school the year before was still casting a positive model on the students. In order to entice future female students into the Technology department more needed to be done in terms of having the current females seen as role models to younger students. Recruiting more female teachers as well as teacher aides is the fourth positive outcome of the findings.
The socio-cultural stigma of tradition of male and female roles appeared to be given precedence over female students participating in Technology Education. The socio-cultural belief that females have a role and it is not in the hands-on workshop area was part of the culture in this workshop oriented setting.

Trade schools were relevant in the working class area where the school was located but to date this aspect of Technology Education did not appear to have been an inducement for female learners to engage in Technology Education. This aspect may change over time as trade training is further embraced by the school.

The trade focus mixed with gendered male dominated language has shown that females will opt out rather than into these courses. The female students aim for quality work, done with precision will meet with time factor issues in Technology Education departments in schools. This was opposite to how the male students operated, quick and fast. The quote by the HOD that, \textit{they are doing a good job, rather than a big job} (H3) is evident in the work the two groups undertook.

Overcoming traditional domestic cultural views of the role of males and females and their future work roles was a hurdle in Case Study 3. This was reinforced by the ‘industrial’ nature of what the Technology department seemed to be promoting. The female students saw the worth of their contribution to the community through projects such as painting the church hall. The females saw the sociological aspects of the class (the service that extended beyond the school room) executed through the skills they learned, as the most important factor they could learn for later use as a life skill. The applicability for themselves now and in the future made a difference in terms of the practical skills which they may or may not use in their homes. The white Anglo-Saxon male teaching staff and the choice of projects within the overall program reinforced the social stereotyping of Technology Education as a male domain. The inherent social structure was to the detriment of future female learners. Without more reflection and encouragement to challenge the ‘norms’ of what they were engaged in within Technology Education the females will not find a path to progress forward to engage and use technology. Without a clear direction they cannot become role models for others.

Finally, the concept of values was recognised by the female students as relevant in terms of what they could learn and apply from this study. There was, however, no depth of understanding of the social aspect of the term values or its applicability. Short term immediate values with respect to pride in completing a job that was valued by the community did make a difference to the female students. Sustainability and recyclability were not factors which made a difference to students.
8.4 Contribution of the study

8.4.1 Contribution to knowledge

This thesis contributes to knowledge and practice in terms of the seven areas of analysis concerned with females and Technology Education. These comprise: the ecology of classrooms, gender, language use in classrooms, motivation and peer support in a socio-cultural context, and values.

The first contribution of this thesis relates to knowledge in terms of our understanding of classroom ecology and the symbiotic relationships that exist. It is the relationships which drive the learning environment and are key to how female learners who are new to this subject area will learn to function. How female learners interact, in order to achieve in this environment through social, emotional and technical support has been identified in all of the case studies.

The second contribution identifies the factors that encourage female students to enrol in Technology Education classes as participants. The learning, thinking skills, physical skill development, and project management are enablers of learning and equippers of future learning. If Technology departments provide adequate time to female students to develop skills and language that enable them to function confidently in the workshops then perhaps more females will come into the subject to participate in the female oriented pedagogy, as senior school participants. Scaffolding and problem solving in an open context which enables female students to have choice and make decisions will motivate them to choose and engage in Technology Education.

The third contribution to knowledge is in terms of gender differences within a Technology Education learning environment. There is no such concept as a gender neutral curriculum. The thesis has illustrated that despite recognition of gender equality in the era in which we live there remains a need to alter traditional community beliefs and entice more female participants into Technology Education workshops.

The study further contributes to knowledge by identifying that the language in some Technology Education classes is controlled by males. Language combined with the notion of gender and who controls language use, has shown that the majority of the female participants in the case studies did not exercise their voice in Technology. They deferred to the male teachers and learned as quickly as possible relevant terminologies and practices which enabled them to function in the workshops to realise their artefacts and achieve as learners.

Peer support and shared achievement goals supported the female Technology students to be able to reach the levels of success which they did within the case study projects. Peer support was not always female to female. In one of the studies, it was exclusively male and female. In another it was mixed genders. At times, this became one of the females providing the
support. The discussions, the interactions and analysis that occurred within the small groups progressed and clarified the learnings. These informal interactions were often underestimated by the teaching staff.

The sixth contribution is in the use of socio cultural liberal feminist lens which looked at what differences there were between male and female learners in Technology Education classrooms. The issue of female participation has not been addressed by treating all students the same. Female students need collaborative participative learning strategies, to project plan and show that they can make a social difference through Technology.

The final contribution to knowledge is concerned with values. The analysis identified that teachers overlook value systems concerned with contemporary issues such as sustainability through a presumption that they have covered this area in the past and moved forward.

8.4.2 Contribution to practice
The study has contributed to practice in that it has highlighted that there is a need for the enactment of a female pedagogy. Females do learn differently and do perceive the nature of the world differently to their male counterparts.

In this respect, female participants must be addressed differently at the sales point of the subject. The difference in interaction needs to continue on entering and being part of the Technology classes until the students learn the skills to find a comfort zone in the class. Finally, if female learners are shown where the outputs of learning in Technology Education may take them in the world outside of school in terms of learning pathways and careers they will identify with the relevance of the activities. Whole to part, and parts to big picture, whole thinking is the hallmark of female thinking styles, as illustrated in the three case studies. The same applies to the relevance of projects that are provided for female learners.

Given the changes in the nature of Technology Education in Australian education, it is timely that this socio-cultural study has been undertaken. The advent of the Australian Curriculum for Technologies for early to middle school learners may make a long term difference to female students readily entering Technology departments. Prior experience by female learners with Technologies, and not limited to computing, in primary and middle school Technology Education may make a difference to their longer term engagement in the subject area in senior high school and beyond. The study makes a contribution to the curriculum through the identification of thinking skills and process planning and teaching strategies that female learners identify with.

Finally, the ethnographic approach, interwoven with the feminist perspective has provided the potential for transformation in research and learning in Technology Education. The examples in the case studies and proactive practices in some of the case study sites have been
documented for use by others. There are clear educational practices which can be transferred to other Technology Education settings.

8.5 Suggestions for further research

The study in this thesis was conducted in three high schools. The quantity of data collected was significant, but undertaken over a reasonably constrained time frame, as appropriate for a PhD study. However, it may be useful to conduct a longer study to gain a more detailed understanding of the phenomena observed. A longitudinal study could be implemented. Such a study, which followed female students over more than one academic school year could look further at the transitioning intersection between females in the junior school to those going into the senior school.

The study could be replicated in a wider range of settings. The sites in this study were urban and suburban schools based in and close to a capital city. Conducting the study in rural and regional areas away from suburban students may yield different results.

A Design and Technology program could be developed based on the findings of this research. It would aim to meet the needs of female students with the aim of attracting them into Technology Education and the STEM area.

Socio-economic difference was addressed briefly with regard to the location of each school in the case study. One of the case study sites was located in an affluent urban area while another was in a working class lower socio-economic suburb of a capital city. The third case study was an inner urban school. The study could be replicated in any Technology Education classes due to the diversity of content. A focus on the socio-economic backgrounds of the participants within the case study sites may provide a unique lens for review and reasons for further engagement of females.

Finally, there is a need for researchers to revisit the understandings of students of Technology with respect to values education. Several junctures in this thesis have pointed to areas where teaching staff believe that the concept of values and goal setting has been ‘done’ and is presumed knowledge. The anecdotal results have shown that staff avoided these concepts due to their lack of confidence or need to engage in the concept. There is scope for further research in many of the thematic areas which have been addressed in this study.

In conclusion, increasing female participation would appear to involve a combination of values orientations, curriculum content, pedagogy and cognitive challenges in a safe and supportive environment. The importance of relationships through support and modelling as well as acknowledging difference was the key to the plurality of the approach that could increase female participation in Technology Education.
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