ABSTRACT
This paper provides early findings from a research study undertaken in 2013 in a number of Queensland high schools. The study examines some factors that could heighten the participation of female students in technology education classes, and focused on female students in senior secondary schools.

The research design used an ethnographic case-study methodology. This design allowed the research to unpack a credible, rigorous and authentic story of female students’ involvement in different design and technology contexts across different schools.

The study was intended to give a voice to female students in order to understand the nature of their involvement in design and technology subjects. The researcher was seeking to understand the reasons why female students had undertaken courses in design and technology education, and explored the realities of each classroom environment. The culture sharing group was identified as Year 11 girls participating in the early stages of technology education courses. Field data was collected in an authentic setting and included audio recordings of language and interactions. Recordings of interviews with students and adults were made. Both situations were designed to allow for the use of verbatim quotations and thick descriptions of the context and events in order to understand and unpack the female voices in the study. Artefacts became a key component of the discussions. Triangulation of the data in the research design aimed to overcome any research bias and allowed the researcher to more fully understand the social and cultural scene.

The study investigated such aspects as the social construction of reality, the nature of teaching and learning in context, the values that motivate participants and the ecology of the learning environments from a gendered perspective.

Keywords: technology education, females, pedagogy.

INTRODUCTION
Three aspects of the research will be examined in this paper. The first aspect is the nature of gender and the learning construct, and the links to the theoretical aspects of the study. The second is the learning environment in the context of values and language. Finally one case study will outline some of the issues relevant to females involved in technology education.
This paper presents preliminary findings from a research study conducted in one high school in South East Queensland during semester one of 2013. The study aimed to examine what factors could heighten the participation of female students in technology education classes. The focus was on girls, predominantly in the senior secondary years of schooling, studying within a school’s industrial technology department. The aim of the study was to give a voice to female students in order to understand the nature of their involvement in design and technology subjects. The study also sought to gain an understanding into, the reasons why, the female students had undertaken such courses, and explored the realities of each classroom environment.

METHODOLOGY
An ethnographic case study approach was used to analyse the learning in the design and technology classroom which is the focus of this paper. This approach allowed the voices of the girls to be heard during the research, which was conducted over fourteen weeks. The researcher became a participant observer in two classes in an independent school in the western suburbs of Brisbane.

Data was collected from students, teachers and the Head of Department. The professional subject association, school administration and staff provided access to timetables and classes. Artefacts that students were designing and constructing were a key component of the discussions around what the students were engaged with in the technology classes. Observations were triangulated with responses collected from both staff and students at the site. This paper reflects some early findings.

BACKGROUND AND THEORETICAL FOUNDATION
The topic of the study has been under-researched in Australia, especially in the post – compulsory years of schooling. The use of language, its implied knowledge and gendered nature, added a further dimension to the analysis. Feminist writers have claimed that the connection between masculinity and technology, reflected in women’s underrepresentation in the STEM (science, technology, engineering and mathematics) areas, continues to diminish the worth of females in these occupations and professions. Studies such as this are aimed at identifying factors which will provide success for female students in technology education. The findings of this research will have long term flow on effects for females transitioning into higher education institutions, with the aim of making the STEM pipeline more sustainable.

Despite the fact that a body of literature on gender and technology has existed from the mid-twentieth century onwards, few in-depth studies into gender and values in technology education have been completed in recent decades (Lerman, Oldenziel, & Mahun, 2003). Even fewer studies have taken place in the secondary school domain. In an Australian context, no research to date has examined the National Syllabus in Technologies and the fit with females in senior secondary education (Australian Curriculum Assessment and Reporting Authority, 2012). Whilst there has been much written about females in education and technology historically, and the sociological relationship of women to technology, there is an absence of research in this area (Stanley 1993, Lerman, et al., 2003). Writers suggest that research has been fragmented or at times relegated to the ‘black box’ (Crilly, 2010). During the last decade there have been calls for gender research, but few 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.

THE NATURE OF GENDER AND LEARNING CONSTRUCT
Learning within a techno-social sphere may be the best environment for females. Bijker (2003) 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 knowledge, goals and values, as well as artefacts (Bernstein, 2003 ed.). Social constructionism
is a social concept, a practice that is the construct of a particular group. Social constructs are not those given by nature but ones that must be constantly maintained and re-affirmed in order for them to persist.

Social constructionism in the post-modernist movement defines gender as being socially constructed. Gender is not created by nature as a result of biology but rather is created by, and contingent on, social and historical processes (Oldenziel, 2003; Restivo & Croissant, 2008; Stanley, 1993; Vygotsky, 1986). Sex is a descriptive category used to designate female and male. Rothschild (1988) argues that gender is a social category (Rothschild, 1988), while Petrina (2007) claims that differences are not determined by biological sex. It is argued then, that by changing the social and environmental factors from ones that reinforce stereotypical behaviours to ones which better suit girls, their interactions, engagement and learning will substantially improve in technology education classrooms. By making the environment more female friendly, we improve the social and cognitive ability of female’s learning. These actions, it is argued, will improve retention and participation rates of female students. In the longer term this may influence the uptake and flow on to tertiary courses in fields such as technology and engineering (2007).

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

THE LEARNING ENVIRONMENT IN THE CONTEXT OF VALUES AND LANGUAGE

To move forward, Wajcmen says

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).

In her techno-feminist framework Wajcman talks of the mutually shaping relationship between gender and technology that is a source and consequence of gender relations. It naturally follows that space is created for transformations of women’s agency in education. ‘Socio technical networks provide a path forward for women who are reflexively aware – able to choose their own lifestyles and identities’ (Wajcman, 2004, p105).

Petrina (1998) in discussing teaching methods claims that some groups may require differential treatment to have a fair chance of participating and performing. Equal outcomes may require differential treatment, as he stated:

We have to attend to the barriers as well as intervene in the status quo conditions to achieve equity and equality in technology studies. Biases are hidden and subtle as well as obvious. Sex-bias or sexist curriculum materials in technology tend to give girls the message they are not important. Language that is not consciously gender-specific tends to default to the male in technology courses (Petrina 1998, p.335).
Values, which are often treated as gender neutral, have been examined as part of this research. Pavlova’s (2009) research addressed notions of values in terms of sustainability and access. It is the issue of personal values which underlines the feminist perspective, and the way in which this translates into education at the local level, which relates to this study.

The empirical work of Rokeach (1973) underpins the values, explorations and the definitions which have endured over time, as well as applicability across contexts of learning and human endeavour. A value is an enduring belief that a specific mode of conduct or end state of existence is personally or socially preferable. Values, like all beliefs have cognitive, affective and behavioural components. Two types of values – instrumental and terminal – are identified, the latter resulting in activity with an end goal in sight. This applies to students who had already made career choices in terms of subjects, such as technology.

**LEARNING ENVIRONMENTS FROM A GENDERED PERSPECTIVE**

Technology as a system has the potential for the distribution of power. It is the importance of context in understanding technology, and the importance of technology in understanding society, that takes us past the ‘old’ boundaries that we have been burdened with in the past (Lerman, et al., 2003). Environment and language are two aspects which are examined in this study. The supportive nature of teaching, and teacher allowance for flexible learning, cater to female learning styles.

An awareness of the feminist issues is critical to assist educators in overcoming the stereotyping that still occurs subliminally in language discourse and enactment. One off programs to promote STEM and entry into engineering programs have not proved to be solutions in the long term. A recent study by Riegle-Crumb and Moore (2013) which examined Texan high school students entering engineering courses observed similar patterns to those in post-secondary engineering. Despite the fact that their study covered a new engineering course, the female attitudinal results of the year-long study showed less favourable attitudes toward engineering in an environment that was less inclusive than that of their male counterparts.

Language can convey the essence of the subject. It can provide a particular message which females use to form an opinion of the subject and its applicability to themselves, and subsequently of their engagement. The concept of gendered language, as expressed by Spender (1985 ed.) was a consideration in this study. The cultural norm of language, expressed in the various ways in which teachers address students, are indicative of the masculine language of invention (Odenziel, 1999, Bijker, 1995). Fox-Turnbull’s (2010) research on peer and quality conversations may assist in drawing conclusions in relation to female participation and dialogue.

The technology education curriculum, using the language of technology, needs to incorporate the diversity of people, positions and values in order to reach all students. It can serve as a socially valued subject in the school curriculum (Zuga, 2007). Technological literacy and its links to language, values and understanding will provide the criteria and links to teasing out actions in the classroom.

The second aspect of language is the question of when opinions are formed by females about what they will study. Ford’s (2011) study found that it is during the early years of education that gender and career decisions are made. Female students’ opinions are formed via the language used at home. Curriculum enactment which shapes the engagement of girls in the subject, along with confidence gained through the language of achievement, makes some difference. In examining the data from female participation and performance in technology education, it is found that less than ten per cent of enrolments are females. Nonetheless, those girls who do enter technology classes achieve higher level results compared to their male counterparts.
THE CASE STUDY AND EARLY FINDINGS: DISCUSSION
The researcher was a participant observer attending Years 11 and 12 classes consisting of three female students and a balance of 15 to 17 males. The study followed one unit of work from the design phase to realisation of the artefact.

Data collection included observation checklists, field notes, written reflections after each class visit and audio recordings in the classrooms. Interviews were conducted with the Head of Department, the teacher and the female students. A set of open ended questions were provided to participants. A reparatory grid was completed, based on the designed and constructed artefact. The researcher viewed the students’ folios and discussed the results with the teacher. Photographs were taken during each lesson.

THE NATURE OF GENDER AND LEARNING CONTRUCT
Teacher support was critical in the classes observed. The teacher was encouraging and supportive, demonstrated techniques and made time for the girls in the class. ‘I want you all to get top results,’ said the teacher. The female students lacked the hand skills and technique of many of the male students. None of the girls studied the full range of technology subjects available.

In the workshops the girls tended to cluster in a workspace or with a supportive male peer. When asked about their location in the classrooms, students did not see this as a conscious decision.

The school’s timetable was a discriminatory factor. By timetabling a creative arts/fashion subject in the same slot as a technology subject, a gendered division appeared to be reinforced. Ford’s (2011) research showing why female students do not remain in technology classes would appear to be substantiated. When selecting subjects, the social beliefs of the parents and students appear to keep some of the females out of technology classes at this school.

THE LEARNING ENVIRONMENT IN THE CONTEXT OF VALUES AND LANGUAGE
The female students worked hard to achieve their goals. The teachers supported the development of their ideas in the theory classes, and these were later translated into the workshop settings for the development of artefacts and for the completion of assignments, reports and folios.

The supportive nature of the classes and the lack of same gender competition was one of the significant observations made in this setting. The social nature of learning, as against the competitiveness of the male students, meant that the females enjoyed the learning environment.

Teacher pedagogy catered to the particular girls in the workshops, however the girls required more female oriented projects and approaches in order to become motivated and engaged. Specific terms were explained and discussed, and were clearly directed at the females. The girls’ lack of background experience was acknowledged by staff members, along with the need to explain terms and specific tools required to complete a task. These included explanations about the differing requirements for the pitch of a roof, instructions on how to use the aluminium bending machine, and how to link a rocker switch wiring with solder. The language used was pivotal to the task at hand.

The girls in this study did not see any gender bias in their classes. The boys who were interviewed felt that there should be more girls in technology classes. The boys noted that they had some advantage through experience during hands-on and graphic design courses in the early years of high school.
One observation made was of the confidence built through successful activity in the technology classes. While the females were encouraged, they were not sheltered from having to problem solve, create a prototype, and at times fail at a task. Their willingness to engage and take on more difficult concepts expanded during the course of the study. The presence of the female researcher in the workshop made a difference to one participant, who as the teacher said, ‘felt special’ when the researcher arrived.

Promotion of the benefits of the subject to potential participants through female oriented projects, female role models and the long term utility of technology itself, will serve to heighten participation.

IN CONCLUSION
This paper has provided one set of findings from the study. Females clearly want to engage in technology education.

There are many avenues for research in this area and many practitioners who are willing to assist. Teachers and academics acknowledge the issue of the leaking pipeline. Technologically minded females are being encouraged through teaching methods, accommodation, and freedom of choice in technology classes. The use of female teachers in the junior school classes has provided role models for female students. The family social constructs which limit girls’ ambitions towards technology education appear to be the first break in the pipeline while educators are addressing the leaks at the opposite end. It is the aspirational middle students that schools need to be addressing in order to create a sustainable long-term pathway for more females to enter senior technology education.

With the implementation of the Australian Technologies syllabus there will be a change in how teachers approach design and technology teaching in secondary schools. The implied use of a design process, whether learned through information technologies or design and technology, will mean that teachers and students will have a longer span of education to learn about technological processes. This in itself will make technology studies more self-sustaining, as well as changing the optional nature of the subject against other post-secondary options.

REFERENCES


