The digital divide: Are our girls falling through the gap?

ABSTRACT

The comprehensive Girls Tech study undertaken recently by Rutgers University (The World-Bank, 2002) supports the findings of a number of previous studies (Newmarch, 2000; Scott, 1998; Smith, 2005; Walker, 2002) which indicate that some females still view technology as a threatening part of male culture. There is concern about the low percentage of female learners engaging in technology-based courses at a secondary school levels (Comber, 1997; Hough, 2004; Wilcox, 1996). This paper is a search of current literature on brain research and gender based learning. The literature reports that some females prefer specific styles of pedagogy to suit their cognitive processing preferences. Ranges of instructional strategies are discussed to develop a pedagogy that engages girls in technology-based classes.

Immense progress has been achieved in education over the past 50 years. Immense challenges still remain. The main success has been access, but too many people—especially women and girls are still excluded at all levels of education. (Education Sector Strategy, (World-Bank, 1999a)

INTRODUCTION

This is a review of literature that addresses a concern in technology-based education: Young girls are not responding as well as boys to technological opportunities offered in our education system (World-Bank, 2002). My interest in this field has developed over twenty four years of teaching and lecturing experience in the area of primary and middle years schooling. I currently lecture in programs on curriculum studies with an emphasis on the use of ICT in educational settings and inclusive education for early childhood and primary school educators. I am interested in the impact of instructional design and teaching methodology and how we can avoid gender bias in this field. My current doctoral research focus is in the area of cognitive psychology and information technology and how new advances in these fields can inform teachers to adapt their pedagogy to cater for the learning needs of their students.

In this paper several factors affecting the engagement of girls in technology-based learning are outlined. Barriers to the inclusion of girls in technology-based classes are considered from a socio-cultural and a cognitive perspective, and reference is made to current research in the areas of gender, learning theory, educational psychology and cognitive science. Finally, areas warranting future research are highlighted.

The move towards a knowledge based society

There has been a global shift from a society based on producing goods to one based on knowledge production (Bank, 2002; Dutton, 2002; World-Bank, 2002). This has changed the world of work profoundly. For example, many traditional forms of employment have ceased to exist or have been replaced by more efficient methods utilising technology (Hough, 2004). As can be seen when scanning the employment sections of Australian newspapers, a large percentage of employment advertisements require at least a range of basic ICT competencies (Walker, 2002). The data on rates of remuneration for employment show that many of the higher paying jobs require higher levels of ICT competencies. Hough(2004) describes the advances in information and communication technologies, such as the use of the World Wide Web, Internet based communication and research as drivers of change, leading to the creation of new jobs and opportunities. A large number of new forms of employment have been created which utilise these new technologies.

The initial promise for the increased the use of technology in schools was that it would serve to promote better opportunities for all students (Garnham, 2002). Competencies that were previously restricted to a select few, such as the use of computers as a tool for research and design and access to databases would be made accessible to many. There are, however, many challenges for educators wanting to reconceptualize their pedagogy to incorporate these new technologies to greatest effect, and equip learners to take their place in the technologically orientated society they will face in the future.

It is a fair assumption that in order to function effectively in this technological society, individuals need to develop certain levels of ICT literacy (Cassell, 1998; Newmarch, 2000; Walker, 2002). There are
numerous references in the literature which state that
a lack of skills in the area of technology can become a
handicap for learners in their future careers (Comber,
1997; Douglass, 2004; Garnham, 2002; Hough,
2004; Smith, 2005; Wilcox, 1996).

**ICT in Australian Schools**

On the surface in Australian schools, all is looking
good. There is widespread provision of technology
in schools and the majority of classrooms and
schools have been equipped with computers for
over the past twenty years. But if one delves beneath
the superficial impressions, a different picture
emerges. There is a marked difference between the
number of female and males students enrolled in
ICT based subjects in Australian high schools and
this discrepancy seems to be growing. In 2002
only 22% of students enrolled in year twelve ICT
subject Information Processing and Technology
were female. For example, in Queensland girls`
enrolments in higher level computing subjects
remained static at 7% over a five year period
whereas male enrolments rose from 17% to 25%.
(Stieler, 2005). The proportion of women
enrolled in undergraduate tertiary ICT subjects
in Australia is approximately 19%, decreasing as
the levels of the coursework increase (Anderson,
2000; Scott, 1998). It follows that there are
significantly fewer female students than male
students in these courses at a postgraduate
tertiary level. These figures are in stark contrast
to the data on general school achievement,
where females are tending to out perform males.
If female students continue to avoid participating
in these opportunities to develop their
competence in ICT they are at risk of being
excluded from many avenues employment in the
future.

Considering the importance of ICT skills outlined
above, this raises the following question: What
are possible reasons for girls’ lack of engagement
with technology? Hence the literature search for
this paper.

**Gender and learning**

There are many indications of gender learning
differences in the take up of new technology.
Gender-schematic theory proposes that an
individual’s sex is biologically determined, but that
the individual socially constructs gender on an
ongoing basis. Young women can be influenced by
societies’ stereotypes, which designate what activities
and skills are socially acceptable for women.
This can lead to young women being discouraged from
pursuing interests in a technology related field
(Douglass, 2004; Wilcox, 1996).

Another consideration is the way that females learn
(Fogarty, 1997; Gardner, 1999, 2004; Guenther,
1998). Whilst they do not all learn in the same way, there
is a distinct range of learning styles preferred by female
learners. Females tend to prefer learning that is language-
based, involving discussion and collaborative group work.
Females tend to become stressed by situations that are too
competitive and those that involve violence or aggression.
Females also tend to enjoy working in environments that
are attractive and nurturing (Anderson, 2000; Cassell,
1998). I will return to these preferences below when
discussing an appropriate pedagogy for girls in ICT.

**Females’ attitudes towards technology**

Recent studies show that some females view technology as
a threatening part of male culture (Comber, 1997, Smith,
women’s lack of confidence regarding computer use to the
time spent using computers for recreational purposes.
Research indicates that adolescent girls spend less time
playing computers games and using computer technology
in their recreation time. A number of research studies
report that this is because most computer games are
designed by and for males (Comber, 1997; Douglass,
2004; Smith, 2005). Newhouse and Bursey indicated that
boys were more likely to experiment with new software
than girls, although with increased exposure girls gained
confidence in using a new program (Newhouse, 2004).

A comprehensive study “Evaluating electronic information
resources for young women” was undertaken recently by
Rutgers University (Douglass, 2004). This research project
found that many females find computer games aggressive
and that they target traditionally male-orientated interests.
Games based on competition, rules, demonstrating
mastery over opponents, and reactive violent responses do
not appeal to many female players. The literature reports
that females prefer collaborative, authentic problem
solving with plausible female characters (Cassell, 1998;
Douglass, 2004). The dearth of well-designed computer
software appealing to females could be a reason for young
females spending less recreational time engaged in
computer-based activities, and for their lack of confidence,
which has been termed gender related self-doubt
(Comber, 1997). However, there are emerging examples
of software design that is appealing to both male and
female players, for example “The Sims” computer game
uses family themes which are appealing to female players
(Wright, 2000). Software developers are realising that
there is a large relatively untapped market of potential
female game players so it makes good business sense to
design games that appeal to both genders. This broad
ranging appeal made “The Sims” the top selling computer
game in the year 2000.

There are other issues of social exclusion, which females
have experienced when trying to engage in online
communication forums. Wilcox (1996) reports incidents
of gender-based intimidation involving ‘flaming’
occurring in online chat rooms. Flaming can be described
as immediate, generally negative emotional response to a
statement made by a participant in an online environment.
Brain research and gender based learning

Research in the field of cognitive science has revealed new evidence about gender differences in the human brain (Gazzaniga, Ivy, & Mangun, 2002; Pinker, 1999). The Nobel Prize winning research of Sperry (1991 cited in Woolfolk 2004) on split-brain theory supports the idea that females often use less of the right side of the brain than males for working through complex mathematical based problems. Thus girls use less of the more holistic, intuitive thinking that is most suited to the computer-based environment.

Furthermore, the development of new brain scanning techniques has resulted in more detailed information on brain activity in living subjects. Positron emission tomography (PET), developed in the 1970’s, measures increases in blood flow associated with neuronal activity (Dobbs, 2005). Positron scanning techniques now show marked differences in the structure and functioning of male and female brains (Gazzaniga et al., 2002; Guenther, 1998; Johnson, 1993; Mundale, 1998; Nuckolls, 1998; Pinker, 1999). For example it has revealed that the male brain develops and matures from the anterior areas that control motor skills and physical abilities (Gazzaniga et al., 2002). Whereas female brains show cortical maturation from the frontal areas that control thinking and language skills. The areas in the left hemisphere, namely Brodmann’s area, Broca’s area and Wernicke’s area, which are responsible for auditory-based language, mature and develop at a faster rate in females (Bellugi, 1993; Fogarty, 1997; Pinker, 1999). Thus many females prefer to learn through auditory language-based methods. It could be that the instructional strategies used in technology-based lessons do not promote this style of learning, which could be influencing the level of engagement of female students with technology.

More recently, another method of brain scanning, functional magnetic resonance imaging (fMRI), has been developed. The advantage of this method is that it allows us to watch the brain at work. fMRI scans can produce an image of a cross section of the brain in less than two seconds, and unlike the positron technique, which involves intravenous materials, fMRI scanning is non-invasive. The scan records raised levels of magnetism that occur when fresh oxygenated haemoglobin is detected in neural tissue. This flow is interpreted by researchers to indicate neural activity (Wiles & Wiles, 2003). The fMRI scans measure neural activity by detecting increases in blood flow associated with increased mental activity in a particular region of the brain. However, critics of this technique feel that these scans are still too slow to accurately measure neural activity as neurons fire very rapidly (Dobbs, 2005).

Although this technology is still new, and is not as accurate as scientists would like to be, it can reveal valuable information about brain activity (Dobbs, 2005; Kellogg, 2003; Smith, 2005). This new research shows us that some males and females can prefer to learn in differently. For instance, it reveals that males often use areas in the right hemisphere of the brain (responsible for processing visuo-spatial functions), to process abstract tasks. This type of holistic, visuo-spatial processing as required in technology-based subjects tends to use the right hemisphere of the brain. The type keyboard-screen interaction is better suited to males, whereas a talking-listening computer would be better for females. Where females predominantly prefer the more linear language-based tasks utilising the left hemisphere of the brain.

Gender, motivation and learning styles

Research in the field of human psychology also shows differences in motivation and motivators, which could explain why males tend to engage in this area and females do not engage. For example, some studies have revealed that females are highly motivated by the need to be popular (Smith, 2005; Woolfolk, 2004). In co-educational schools, this manifests as a need to be popular with the opposite sex. Could girls be exhibiting a learned helplessness in the area of technology in order to be popular? This could be in line with the norms of socialisation and peer pressure that “girls are not meant to be smart” and the notion that “computers are boys’ toys.” Research has shown that males are more motivated by individual competition and the need to prove mastery in an area (Cassell, 1998; Comber, 1997; Gardner, 2004). This type of competitive behaviour is integral to the design of many technology based games and activities.

The literature on learning styles and dispositions has indicated that males are more inclined to take risks than females (Dewey, 1909; Guenther, 1998; Worrall, 2002). The successful use of new technology involves taking risks and experimenting. Those learners who lack the confidence or the disposition to learn in this manner are less likely to successfully profit from the use of new technology.

The use of positive role models has also been shown to have a significant effect on learning (Comber, 1997; Douglass, 2004; Newmarch, 2000). It is of significance that we are not providing our girls with female role models in the area of technology. On checking the media, a higher proportion of the role models in the areas of computers and technology are male. The image of the computer expert is usually a Bill Gates type figure. Female learners find it difficult to identify themselves with this stereotype presented in the media (Pink, 2005; Scott, 1998; Smith, 2005). There are seldom examples in popular media and culture of women who excel in the area of technology. Furthermore, a higher proportion of technology instructors are male (Pink, 2005; Scott, 1998; Smith, 2005). These factors could be influencing the higher levels of engagement of male learners in this area.

Cognitive psychology adds another dimension to this review of technology and gender. There is much research on the significance of matching students’ learning styles and the instructional strategies used in the classroom (Buzan, 1995; Fogarty, 1997; Gardner, 1999, 2004; Guenther, 1998; Kornhaber, Fieros, & Veenema, 2004; Morgan, 1997; Spletter & Sharp, 1995). The research is indicating that the instructional
strategies used when teaching technology-based subjects do not match or suit the preferred collaborative language-based learning styles of female learners. Studies documenting the instructional strategies used in technology-based classes show that teachers use different instructional strategies when dealing with male and female learners (Morgan, 1997; Newmarch, 2000; Wilcox, 1996). When male learners encounter a problem, the teachers tend to encourage them to find a solution to the problem. When female learners encounter a problem, the teachers often solve the problem for them (Scott, 1998; Smith, 2005). This type of behaviour does not encourage the females to be resilient and problem solve but entrenches feeling of helplessness (Anderson, 2000; Cassell, 1998).

Although a number of studies, as stated above, report on this behaviour by teachers there is little evidence in the literature as to why teachers treat male and female learners differently in technology-based learning. This indicates the need for further research in this area.

**Developing a pedagogy that engages girls in technology-based classes**

While clearly more research needs to be done on this topic, one can tentatively propose the following instructional strategies that educators can incorporate into their pedagogy to cater for the range of learning styles and needs of the learners in their classes. Educators need to ensure that software selected for computer and technology-based classes are appealing to both genders. There should be a combination of competitive and collaborative work. There should be a balance between individual work and group work. Problems and scenarios need to be authentic and include realistic gender representations of both males and females. The content of instructional materials should not have people engaged in demeaning pursuits or depicted in passive roles (Cassell, 1998, Douglass, 2004). Activities should contain language-based linear processes as well as the more global holistic activities.

There should be an attempt to use positive role models of both sexes to motivate learners to participate. Educators should be aware of sociocultural barriers to participation for some learners, who may have been socialised to think that females are not expected to be good at technology-based activities. Educators may need to take active steps to break through the stereotypes that limit engagement of female learners in computer and technology-based classes. Schools can promote female role models who have excelled in the area of technology. They can invite females who are working in the field of technology to speak to the students. Examples from the media of positive female roles models can be shown to the students. Work experience programs can be established so that females develop a realistic picture of what future work in the areas of technology involves.

Schools can encourage young females to engage in recreational computer use by forming gender friendly computer clubs, with some activities based on the collaborative interests of females. If necessary, schools can establish sex segregated computer classes to encourage girls to participate without harassment or domination. Schools could use one of the checklists or guides to ensure computer software purchased will appeal to females, for example the guide developed by the Rutgers University Girls Tech Project (Douglass, 2004). Computer programs like Robolab, which have been specifically designed to encourage the participation of girls, can be promoted in classes at an early age before stereotypes and negatives attitudes towards ICT and technology are established (Fleet, 1995). Schools can make computer software available for loan in their libraries to encourage girls to try out new software. Technology educators can ensure that the technology rooms and computer laboratories are aesthetically appealing to females so that girls feel welcome in these areas.

**CONCLUSION**

This is an area in which there are still many unanswered questions and unexplored issues. As noted at the outset, there is a huge demand for workers in our society with technology-based skills, yet we have a large proportion of girls not choosing to follow this line of study in high school. Educators need to change the instructional design and the teaching methodologies to engage the girls in this vital area of their education. Educators need to be sensitive to the numerous challenges and pitfalls when designing learning experiences incorporating technology. There needs to be a synergy between instructional design and teaching methodology that promotes positive learning experiences for both genders. The literature has shown that a large range of factors need to be considered when designing technology-rich learning experiences, for example nature of the content, social stereotypes, the aesthetic appeal of the venue and the design of the learning materials. A significant factor is the instructors’ teaching style, which needs to support the preferred learning styles of the students while encouraging resilience and independent confident thinking. Educators must be aware of the dangers of stereotyping and limiting the opportunities of females by over simplifying learning activities. Technology-based classes need to include a range of learning experiences so that learners can select those that best suit their learning style and needs.

Further investigation is recommended on the significance of skills training in this area for the future success of females in the knowledge-based economy. The links between early computer use and later confidence in the area of technology also warrant more investigation. Technology educators and their learners need to be consulted and their opinions sought on how this issue can best be resolved in Australian schools.
REFERENCES


