Technology- a fair go for girls.
The need to make the classroom inclusive of girls.

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Abstract

This report examines the issues surrounding gender inequalities in technology education. Firstly gender bias is looked at in detail with regards to why girls, in particular, are less exposed to the necessary construction play that builds technological capability and the effect that this has on girls. The second part of this paper reviews the literature surrounding classroom teachers' pedagogies and practices to suggest how gender bias can be reduced in technology.

Introduction

This report has been written in response to research that highlights the fact that the technological literacy of girls and women is considered to be low (Burns, 1997). In most countries, including New Zealand, there is an under representation of girls in science and technology education. Girls tend not to select technology as an option when given the choice (Burns, 1997; Silverman & Pritchard, 1996). This creates a problem as in New Zealand it is recognized that "technologists are not emerging through the education system in high enough numbers to provide the basis of a highly educated work force (Farmer, 1992). The reasons for this bias need to be explored because at present technology is a gendered subject, associated generally with males (Lewis, 1999). 'This is a major stigma for the subject, and thus a natural and high priority area of research' (Lewis, 1999, p. 47). This report considers the negative influences on girls' participation in and enjoyment of technology.

This report was undertaken to determine how technology could be made more inclusive to girls. The research challenges teachers to scrutinize their beliefs about gender and about technology. Technology needs to be made meaningful to both girls and boys but as the authors of the book *Women's way of knowing* contend, girls are more disadvantaged by teaching styles that do not make connections between the real world and technology (Belensky, Clinchy, Goldberger & Traule, 1989, as cited in

Silverman & Pritchard, 1996). A different pedagogy needs to be undertaken in the classroom when teaching girls (Kruse, 1992, as cited in Burns, 1997). The implications for practice are highlighted and will be explained further in this paper.

Gender Bias

One issue in terms of girls and technology education is the fact that girls do not use construction and mechanical toys as often as boys do (Brown, 1993). This is an important factor in nurturing technological literacy. It contributes to girls' having poorly developed spatial skills and means that girls have little exposure to technology (Farmer, 1992). Brown (1993) in offering an explanation for this, states that the toys that boys and girls are given prior to school age reinforces that there are separate 'boys' toys and 'girls' toys. These toys are normally separated in toyshops so it would be uncommon for girls to get 'boys' toys. An effect of this separation, of girls and boys toys, is that children might not venture into an area or activities that they have identified as 'belonging' to the opposite sex. This can have a detrimental effect on girls because it is usually the male toys that include construction and mechanical aspects of play which involve problem solving and hypothesizing. The consequence of this is that girls end up with less opportunity to play in technology based activities, especially before they come to school (Brown, 1993; Silverman & Pritchard, 1996). Also the media portrays what is and isn't appropriate for girls versus boys.

The Assessment Performance Unit (APU in the U.K.) has reinforced the notion that girls lack exposure to technological play. They investigated the leisure activities of school age children and found that the experience of boys playing with construction toys, such as Lego was twice the amount of girls (Brown, 1993). This is important to note when examining the issues with technology and gender differences. It has been shown that 'basic experiences of shapes and sizes and of materials and structures based on practical 'hands on' science, and technology is directly related to children's later abilities in technology' (Brown, 1990, p.137). The APU also found that the different experiences of pupils, outside of school, affects not only the skills they develop but also their understanding of the situations where their skills can be used appropriately (Murphy, 1993).

The APU study showed that children as young as six had formed strong opinions about the kind of activities boys may undertake and those that are suitable for girls. The gender stereotypes that have been ingrained in children before they come to school are shown to be further incorporated and reinforced within the classroom (Brown, 1993; Murphy, 1993). Most children still feel that there are 'boys' activities and 'girls' activities. 'Children may feel like they are not entitled to an activity/ classroom area if they perceive it as lying outside their gender domain' (Brown, 1990, p.137). This lack of entitlement which holds girls back in their development of technological skills and interests.

Extensive research has been undertaken into the attitudes of girls and the activities, that increase their technological thinking and capability (Brown, 1990; 1993; Cole & Conlon, 1994; Silverman & Pritchard, 1996). The MESU (Microelectronics Support Unit) showed that girls in classrooms wanted to do more technology but feared that the boys were better at it and felt overwhelmed by them (Brown, 1993). Teachers also commented that girls commonly seem overwhelmed about 'getting it right' and may be unwilling to undertake tasks they are unsure of. In a report undertaken by the New Zealand Ministry of Education exploring teachers' responses to technology, it was found that the main gender issue within the classroom related to boys dominating equipment. This led to girls wanting to do 'girls stuff' where there was less competition for resources. As a result of this tension, girls lacked the confidence to branch out to unfamiliar domains (McGee, et. al. 2002). These feelings contribute to, and influence, girls' problem solving skills and their ability to design experiments and to hypothesize. These processes involve taking risks, and could contribute to a lack of confidence and interest in technology (Riggs, 1994). A contradiction in the research was that of Silverman and Pritchard (1996) who stated that girls have confidence in their abilities in technology however 'emerging sexism among peers begins to differentially affect participation on the basis of gender' (p. 46).

It is important to focus on girls' attitudes because it is argued that children's 'attitudes and approaches to activities are dependent on a sense of entitlement and confidence rather than simply on possessing a particular 'type' of knowledge and aptitude' (Brown, 1993, p.195). The context and the way an activity is introduced, appears to

affect the child's ability and confidence within the topic (Kimbell, 1994). It was interesting to see within the MESU project, many teachers thought that because they offered a choice of activities to all pupils they were giving them equal opportunities (Brown, 1993).

There is little information available from research about what constitutes normal technological development (Brown, 1993). Brown initiated two studies to directly observe how a specific group of children developed over an extended period of time. In order to establish a normative pattern of technological development, a strategy was put into place to establish equal access to the relevant materials. This included setting up structured time for the activities and made sure that the teacher spent one-on-one time with the children getting them acquainted with the activities. The activities were based on construction materials out of a Lego Technic construction set. The results showed that despite the majority of the construction materials used being unfamiliar to the girls at the start of the year:

> given equal access and encouragement, in a normal classroom situation without any positive discrimination in their favor, the girls became confident enough to take part in such modeling and built up experiences of putting technological ideas into practice. (Brown, 1993, p.199)

Brown's (1993) studies and those which investigated attitudes and sense of entitlement to leisure activities involving mechanics and construction were important because they argued that lower levels of involvement in construction activities can prevent girls from making the link between the skills and concepts learnt in a familiar context and those required in an unfamiliar context. Brown (1993) contests that this can impair girls' abilities to transfer skills and knowledge and prevent them from developing flexible thinking.

Research into gender differences (Murphy, 1993) has highlighted the importance of addressing the gender bias messages sent to girls and boys. Chodorov (1987, as cited in Murphy, 1993) related the different ways of nurturing, that many girls and boys experience to the different views of relevance they develop. This arguably contributes to the way in which they view the world. 'As a result children come to school with learning styles already developed and with an understanding of what is and is not appropriate for them. What they judge to be appropriate they tackle with confidence,

what they consider to be alien, they tend to avoid' (Murphy, 1993, p.149). The second part of this paper will identify how the teacher can make the more 'alien' subject of technology more inclusive to girls, so that prejudices can be challenged.

Teacher and classroom influences in technology education

There is evidence to show that the teacher and the strategies used in teaching technology in the classroom play a part in the gender differences in technology (Kimbell, 1994). Teacher behaviour, based on sex stereotypes, can have a detrimental effect in the classroom situation (Brown, 1990; 1993; Cole & Conlon, 1994; Owens, 2000). Spear's (1985) research into teachers' attitudes toward gender and technology showed that 49% of teachers thought that technical subjects are important for a boy's education compared with only 24% rating technical subjects as very important for a girl's education. The problem with these sorts of gender bias expectations is that the teachers' beliefs are likely to be conveyed to their pupils (Cole & Conlon, 1994). "In order to change learning experiences for students it is necessary to change the teaching and the teacher's views" (Burns, 1997, p.128). Farmer (1992) outlined a range of factors that contribute to the problem. These include differential teaching approaches and strategies and attitudes that contribute to the inequality between girls and boys in the classroom. The first of these to be examined is how the masculine image of technology is contributing to gender bias within the subject.

Jones & Carr (1993) outline that a main concern for teachers in helping counter gender bias should be to enable girls to incorporate female values in technological activities and to define challenges and respond to these, on their own terms. Silverman & Pritchard (1996) say that because technology has generally been a male orientated subject, teachers need to consider ways of making the environment and the subject content attractive to girls. For example a study of 'wheels' could include looking at wheels on a pushchair or shopping trolley as well as wheels on a truck or a bike. This would be a gender inclusive unit in which the 'female' contexts are used and valued just as equally as the 'male' contexts. But, it could also be argued that this further promotes gender stereotypes. Mather (1994) argues that there is a high risk that

> characteristics will be attributed as 'belonging' to those individuals who are positioned in this category, leading to the validation, and enhancement, of

> stereotypical assumptions…(these) pervade, constrain and construct various discourses (p. 2)

Technology in the New Zealand Curriculum (TNZC) states that we have to be careful not to be limited by these "traditional assumptions or perceptions of what will 'interest' girls, boys, or other defined groups" (Ministry of Education, 1995, p. 15). A solution may be offering all students a choice and a range of contexts that they can choose to investigate.

Teachers need to look at their own gender bias and how they can challenge their values to improve girl's access to technology. This can be done through different ways such as ensuring that there is a fair balance between objects and experiences that are familiar to the girls as well as to the boys. "All materials provided and their presentation should include full participation of girls…the use of any materials or terminology that present prejudicial images must be avoided at all costs" (Kinnear, 1991, p. 226). TNZC states that we must always critically review materials to ensure that they support gender inclusiveness. This will therefore contribute to technology programs that "recognize, respect, and respond to the educational needs, experience, interests and values of all students: both female and male students" (Ministry of Education, 1995, p. 15).

Another way in which technology can be gender exclusive is through the discourse and language surrounding technology. Language should be used carefully so as to include rather than exclude girls (Farmer, 1992; Cole & Conlon, 1994; Farmer, 1992; Volman, Van Eck, & Ten Dam, 1995). Benston (1988, as cited in Farmer, 1992) explains that

> not only is the language of technology gender biased with a built in logic that is based on profit and power, but the unfamiliarity of the language tends to silence women (p.18).

Farmer goes on to give a powerful example of a classroom in which girls are making eggbeaters out of Lego. She says that when given instructions that include such terminology such as axle, gear wheel, crown wheel, gear ratio, the language would simply just turn girls off (1992).

Learning examples and materials also need to depict girls as equally active and show participation, which have technological aspects. Resources used in the classroom can also give a strong message about the world and what is the 'norm.' Children can readily absorb the images and 'norms' around them, this will also contribute to decreasing the bias and stereotypes that the children have of gender and technology.
It is interesting to note here a contradiction that was discovered in the research. Farmer (1992) highlights that the feminist critique of technology education believes that it is more important to examine the gender construction of the subject. She goes on to say that "feminists state that 'girl friendly' technology education is too simple a solution and will have little effect in arresting women's silent march away from technology" (Farmer, 1992, p. 18). Kinnear (1991), Brown (1993), and Burns (1997) disagree. They argue that making the classroom and subject content girl-friendly does contribute to gender inclusiveness and effect girls' self efficacy and their confidence levels, which contribute to them feeling as if they can succeed and be included.

Teachers need to incorporate female images, materials, and activities that include girls, and they also need to adjust their pedagogy when teaching girls (Burns, 1992). Studies in the gender and education literature imply that teachers play an important part in the development of girls' potential (Acker, 1988, as cited in Riggs, 1994). A research project, conducted in Manchester, showed that one of the three major factors responsible for the lack of attraction to technology by girls, was because of their lack of self-confidence (Kelly, 1987, as cited in Riggs, 1994, p. 217). An example of this is the way in which girls and boys tackle problem solving in technology. While boys are usually ready to have a go and adopt a 'trial and error' strategy, girls are more reluctant to start. This is because girls are unsure of 'having a go' when the task is unfamiliar (Brown, 1993). However given more time and encouragement, girls' self confidence will increase and girls will come to be as successful as boys. 'How teachers judge such reluctance in girls will reinforce or will help to overcome lack of confidence many girls feel' (Riggs, 1994, p. 218).

Girl's and women's socialization means that they bring to learning experiences, perceptions that are quite different from their male peers. The classroom environment in which technology education has traditionally been taught has been an unfamiliar

place to many women. A 'girl friendly' environment would need to involve teaching and learning strategies that involve a focus on co-operative learning and peer support (Brown, 1990; Burns, 1997; Mawson, 2002). Some concerns have also been expressed that when working in groups some children may be disadvantaged because of gender and/or lack of assertiveness (Mawson, 2002). Single sex grouping would work more effectively at first in situations where the context or materials being used are unfamiliar. Further on, girls can be encouraged into mixed pairs and small groups. Brown (1990) adds that if girls are working in a mixed group with boys, the teacher will need to monitor the group and intervene in a non-threatening way if the boys begin to dominate the group. Girls may also need help in asserting themselves by being given time to express their ideas and take an active role (Brown, 1990). Silverman & Pritchard (1996) recommend that teachers discuss guidelines and ground rules for acceptable behaviour in mixed gender groups so as to ensure that girls play an equal role in the classroom and are not forced to take stereotypical roles. This would also make sure boys do not take over, which has been a significant problem when observing mixed gender groupings in group work during technology. Kruse (1992, as cited in Burns, 1997) makes a case for implementing a pedagogy for girls and a pedagogy for boys, developed in response to their different needs, in alternating segregated and mixed groups so that "each group learns from the polarization of experience" (p. 127).

As mentioned above girls often have less access to construction activities that help increase technological skills and confidence. Teachers often, unknowingly, support this by not making a conscious effort to allow equal access to the materials. Teachers need to realize that just having the opportunity of choice is not enough. Girls may need more time by themselves to familiarize themselves with materials that boys would normally be familiar with. Teachers (including those from early childhood) should include structured time rather than just free time with these types of materials (Mawson, 2002; Murphy, 1993). This not only allows both genders to be given equal access to the materials but it ensures it. It also sends the message to girls that the teacher values the activities and that girls will not be given the opportunity to opt out for other work.

The importance of allowing children plenty of time to play and explore materials is strongly evident. The following are two approaches used in early childhood settings that are applicable to developing technological literacy and capability in children. The first relates to unstructured play in which children are naturally problem solving and designing. The second approach relates to the more structured time, which is necessary to extend understanding and to support learning (Mawson, 2002). Murphy (1993) points out in his recommendations that, for girls to overcome their lack of experience in technology, they need to be faced with problems whose solutions need an element of investigation and problem solving. This will help girls engage with them purposefully. "This is a very different to simply encouraging practice with instruments" (p. 148).

Another crucial aspect that teachers need to keep in mind in supporting girls in technology, is to keep the subject gender inclusive by making the technological focus meaningful to girls lives and relevant to everyday life (Brown, 1990; Burns 1997; Riggs, 1994; Turnball, 2002). Caine and Caine (1991, as cited in Silverman & Pritchard, 1996) stress that while connecting what is taught is important to all students, females are particularly disadvantaged by teaching methods which are not related to their everyday lives. Belensky, Clinchy, Goldberger & Traule (1989, as cited in Silverman & Pritchard, 1996) found that girls respond better to teaching, which relates to their own lives.

There is a need, in teaching technology to introduce knowledge in context in technology as it provides grounds for study that will be of value in later life. This is especially important to girls (Burns, 1997). Activities that include girls could involve adding a technological dimension to everyday objects or events, which are already familiar to girls; for example making a working model of a swing (Brown, 1990). Technology should be presented to girls so that their concern with people, and not things, is emphasized. "Women's interests' center around people and relationships" (Riggs, 1994, p. 220), for this reason the links to everyday life need to be strongly recognized. Research by Turnbull (2002) has also shown that if learning is situated in authentic practice, it is more likely to motivate students to achieve.

Through the review of literature, the issue of girls in technology has been examined in regard to what effect gender bias has on children's leisure activities and the impact this has on their technological development and capabilities. These include such factors as girls not getting the experience and exposure with technology that can affect their later ability in technology, and girls not valuing technology because they see it as being part of the 'boys' domain'. The research also highlighted how gender imbalances can be counteracted by the classroom environment and the teacher's pedagogy. Many implications and recommendations have been outlined about how technology can be made more inclusive to girls by re-designing the masculine slant that is so often given to technology. These recommendations include ensuring that content is kept inclusive of girls and using different teaching approaches that cater for girls. Teachers need to be constantly reviewing resources and critically reflecting on subject content to make sure that it is gender inclusive. Technology education must cater for girls and their view of the world and what is realistic and meaningful to them so that technology becomes an inclusive subject area in which girls' interests and contexts are catered for.

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