Computers in the Early Years: Are we being fair to the girls?

Liz Rosie

In this paper, I will investigate the opportunities for girls in computer literacy, and will examine reasons for these inequalities. A review of selected literature will discuss various theories relating to gender differences in learning in the classroom, and the effect these differences have on female students. Possibilities for change will be considered, how these changes could be implemented, and what this could mean for the classroom teacher. The literature review and discussion has a particular focus on the pre-school and primary school sectors.

In 1996, technology in New Zealand schools was assessed by the National Education Monitoring Project (Crookes & Flockton, 1997). It was found that Year Four girls scored significantly lower than boys on four out of five questions, although there was no attempt to analyse the cause of this disparity. A similar difference in achievement was found at the Year Eight level.

Purdue (1994), discusses research that has been undertaken on computer use and gender differences in the primary school. He says that there is an increasing body of evidence showing that gender inequity exists; a consistent finding has been that males are more interested in, and make more use of computers than females. Silvern et al (in Woodill, 1987:54, in Purdue, 1994:7) found that over three quarters of computer users in a group of four to eight year olds were boys. Keisler (in Woodill, 1987:54, in Purdue, 1994:7) described a preschool in Michigan where the boys created a computer club, and denied the girls any access at all.

De Remer (in Purdue, 1994:7), undertook an extensive study of the computer preferences of ninety two primary school children and found that boys saw the computer as a male domain. However, girls had as much confidence as boys in their ability to learn about computers, and scored significantly higher on a ‘computer liking’ factor. He attributed this apparent contradiction to the girls’ early exposure to computers.

Brown (in Farmer 1992:15), found that five and six year old girls were reluctant to play with Lego. They thought that they would not be as good as the boys, and that they should be doing proper work, like writing. He found that this trend continued throughout primary school and into secondary school. Girls were given few opportunities for informal technological experiences, and were seldom given construction tools as presents. They were not encouraged to help their fathers in the workshop, and girls consequently had internalised that they were incompetent with tools.

Woodill (in Purdue, 1994:8), contends that there is significant evidence of a software bias towards boys. Fisher (in Purdue 1994:8) says that the overall style of software is designed to appeal to boys. Software tends to encourage competitiveness, and generally includes loud sudden noises, and violent action. Even in topics with no inherent gender bias, for example with number combinations, the images and accompanying pictures are often designed to appeal more to boys than girls. The message from the designers of software is clear. Computers are for boys.

Media coverage often reinforces this perception. Nye (in Purdue, 1994:8) found that pictures in computer magazines featured males twice as often as females. Males were pictured as dominant managers and technicians, while females were portrayed as clerical workers or sex objects.

Harding et al (in Farmer, 1992:16), noted a variety of problems that disadvantage girls in the use of computers and associated projects. These ranged from the dominance of boys over classroom space, equipment, and teacher time, to scientific and technological projects with masculine illustrations and examples. They consider girls disadvantaged where they are a minority in the classroom. The lack of women role models, and assessment techniques which reward competition over co-operation, are other problems for girls. Kirk (in Purdue, 1994:7) also mentions these last two factors as reasons why girls become uninterested in the classroom computer. He comments that girls often become bored, or see the tasks they are given as irrelevant and unrelated to their everyday lives.

An extensive study by Purdue (1994), aimed to investigate existing gender stereotypes in preschool children's play, and to find out how these stereotypes affected the children's reactions when they were confronted with a computer. Purdue investigated how children reacted to different types of software. He observed the ratio of boys to girls using the computer over a four week period. A two week intervention followed, after which the children were observed again to see if the ratio had altered. The children were also observed in different play areas to ascertain existing sex stereotypes.

Purdue found that boys dominated the computer on most days. Girls came to the fore when a particular painting programme was offered, and when female adults had just been seen using the computer. The intervention of 'girls only time' did not appear to be effective, as the boys then considered the rest of the time as theirs, and consequently the girls were excluded. Purdue also found that sex stereotyping was already well established. Boys dominated the sandpit and the blocks, while girls played with dough and paints. An analysis of the software showed that males were featured most of the time. In four of the six games available, females did not appear at all. The painting programme that appealed to the girls had no characterisation, but the subject matter was sufficient to interest them.

Jean and Geoffrey Underwood (1994), conducted a detailed study of the social interactions among computer users, and reviewed the available literature. A study by Culley (in Underwood & Underwood, 1990:148), noted that lunchtime computer sessions were dominated by boys, who actively worked to exclude girls. Schofield (1995) also noticed this feature of leisure time computer use. Culley found, like Purdue, that 'girls only' times were only partially successful in addressing the problem of boy domination. Culley also noted that during classroom discussions concerning the computer, girls tended to sit at the back or sides of the room, and that boys dominated the discussions.

Hughes et al (in Underwood & Underwood 1990:148) discussed gender disparity in homes. In homes where a computer was available, only fourteen percent of girls said

it had been bought for them, whereas eighty-five percent of boys claimed it had been bought for them or another male in the family. Few girls had access to computers, although most thought they would like to have access.

Studies attempting to discover whether girls performed best when working with a boy, or with the support of another girl, led to conflicting conclusions. In a study by Hughes & Greenhough (in Underwood & Underwood, 1990:149) where young children attempted to move a LOGO turtle around a track, boys performed at the same level with whomever they worked, whereas girls performed best when they worked with a boy. Girl-girl pairings performed badly at this particular task. However, Underwood & Underwood (1994), caution against concluding that mixed gender groups should be encouraged, as these results conflict with their own, and other studies. They considered that the spatial ability required to move the turtle accurately, advantaged the boys. The gender difference in this area is also discussed by Siann et al (in Underwood & Underwood, 1994:151), who considered that much of the evidence pointed to an innate superiority for boys in this field.

Underwood, et al (1994), conducted a similar survey that depended more on language ability, which found that single sex pairs performed as well as mixed pairs. This result was echoed by Findlayson, (in Underwood & Underwood, 1994:154) who conducted a test to evaluate the benefits of LOGO programming and found that, in spite of the fact that boys spent half as much time again using computers as did girls, the girls performed just as well at this particular task.

Underwood & Underwood (1994), conclude that there are no gender differences between computer-based learning and programming tasks. However, a study by Eastman & Krendl (in Underwood & Underwood 1994:155), showed that differences in attitudes existed. Boys considered that computers were for boys, and that boys were more able. Girls were less likely to hold these views.

Upton (1986), conducted a survey of primary school children's attitudes to, and knowledge of, computers. He found marked sex differences. For almost every question, boys showed more interest or involvement than girls. He did not attribute

these differences to anything specific, but suggested that if girls did not see themselves as likely to have a business career involving computers, they would be less interested. This would also explain the fact that girls knew fewer people who worked with computers. Like Hughes et al, (in Underwood & Underwood, 1990:148), Upton found that fewer girls than boys had access to computers at home. He suggested that this could possibly be the result of parental perceptions that boys needed a computer more than girls, or simply that boys were more likely to persist until they got one.

All of the research discussed above, with the exception of the work of Underwood & Underwood (1994) has shown that, where computers are concerned, girls are disadvantaged in a number of different ways, and are not performing as well as boys. Some writers have attributed these disadvantages to the fact that girls learning styles are not being catered for, and others have suggested remedies with superficial changes in classroom methods and teacher attitudes.

Bell (1988), in *Girls and Science*, and Becker, (1995) in *Women's Ways of Knowing in Mathematics*, are two researchers who have examined girls' learning styles. Their works have relevance when considering computer use in the early years and their respective theories are discussed below.

Bell (1998), bases her discussion on two premises. Firstly, she considers that the under-representation of girls in scientific and technological fields is of concern. She points out that our society is becoming increasingly technology-based, and career options are changing. Many traditional careers for girls are disappearing - for example typing and sales - and others, like nursing and teaching, are beginning to require technological knowledge. A working understanding of science and technology is necessary for involvement and decision-making in many debates and discussions affecting modern society, and without this understanding women are disempowered. Her second premise is that an equal opportunity approach to the situation is inadequate. Equal opportunity is insufficient to effect change. Positive action is required if girls are to have a full and rewarding range of career choices.

Research in New Zealand shows that girls have negative attitudes towards science and technology, which Bell considers is largely responsible for their under-representation in those fields (Bell, 1998). In conflict with some of the studies noted above, she says that there is no convincing evidence that girls are genetically less able to achieve as well as boys in technological areas. Girls perceive technology as irrelevant, and unrelated to their own lives. Bell outlines three main themes which explain this alienation.

Firstly, she considers that historically, science curriculums in New Zealand have ignored the ideas and experiences that many girls have. Understanding a new learning task depended on the links that could be made with existing knowledge. If there were no links then there was no understanding. If scientific projects were based on hair dryers, or sewing machines, instead of fire alarms, or search lights, girls would immediately have a better base for interest and enthusiasm. The study of motion, so often involving planes, bullets, and cars, could instead use horses, or birds. She stresses that girls' experiences are valid topics for study.

This problem appears to be addressed in the latest New Zealand science and technology curricula (*Science in the New Zealand Curriculum*, 1993 and *Technology in the New Zealand Curriculum*, 1995). The science document discusses issues relating to girls, and both documents have a range of topics that would appeal to girls. This is a step in the right direction although it cannot be assumed that such topics would necessarily be chosen by male teachers.

Girls tend to be more interested in the human problem that devices are designed to solve, whereas boys are more interested in the device itself. Meeting this perceived need for girls means providing a particular kind of science. This human 'problem-based' science is considered by some to be 'watered down' science. Bell (1998), disagrees with this view and states that where a subject about which girls have no prior knowledge, is being studied, they need to be given time to absorb these new ideas without being made to feel inadequate or inferior. Girls' experiences need to be constantly discussed and valued in the classroom, so that science and technology are seen as a female field as well as a male field.

Secondly, Bell says, girls are alienated by a classroom that is male dominated, and where they feel a sense of incompetence, and of not belonging. All learning involves risk taking, and for girls the sense of insecurity and lack of confidence is intensified by unsympathetic, impatient boys. Science and technology are portrayed in popular literature and magazines as being for males, and girls often complain that the subject has little to do with them.

Thirdly, according to Bell, the image of science and technology is analytical, objective, and not people orientated. This is foreign to the values of many girls, who are more concerned with human problems and issues. The step-by-step scientific process, by which today's students are taught, and the notion that projects must be free from bias to be valid are being challenged, as the significance of prior experience and intuition are being acknowledged. Science and technology are influenced and shaped by society and cannot be regarded as standing alone. Changing the context of the lesson, rather than the content, may be the way to make science and technology more attractive to girls.

Joanne Becker discusses girls' learning styles in *Women's Ways of Knowing: The development of Self, Voice, and Mind* (Becker, 1995). Becker says that while it has been acceptable for women to claim differences from men in moral issues, it is more difficult, even dangerous, to claim differences in cognitive issues. Becker acknowledges the possibility that putting forward women's ways as being different may reinforce stereotypes that demean women's capabilities. She specifies that, by using the term 'women', she does not mean all women, but is using the term as a social scientist, meaning most women, and similarly the term 'men'. She then discusses how Belenky et al (1986) examine the ways women know, and how these differ from men's ways.

Based on many interviews with a wide range of women, Belenky et al (1986) established stages in knowing that have a fundamental difference from the ways that men know. According to Belenky, women's ways of knowing are not sequential, but progress from uncritical to critical. To illustrate the stages Becker used the statement,

'The base angles of an isosceles triangle are equal,' and then indicated what the knower might say at each stage (Becker, 1995:165).

In the silence stage, knowing is subliminal. The knower believes that all sources of knowing are external, and that she cannot rely on her own experience for knowledge. She would not vocalise in any way, but would be aware that the teacher has stated the theorem as being a fact. The received knowing stage is equally as accepting, and the knower still has no sense of being able to assess her own experience for knowledge. However, the knower would vocalise her acceptance. 'I know that is true because my teacher says so.'

The following stage is the subjective stage, and this stage is a powerful one for the knower. She recognises that her own knowledge is legitimate, and that intuition is a recognised force for truth. She accepts the theorem, not only because she is told it is so, but because it looks right to her. Males use this stage differently from females. Men would assert their right to an opinion, while women would be anxious not to impinge on anyone else.

Procedural knowing is a more advanced stage. The knower learns how to construct a series of steps providing evidence that the statement is true. The methodology is important, and may be thought of as the only way. Procedural knowing is further subdivided into separate knowing, and connected knowing. Separate knowing may become adversarial, and is difficult for women. It is characteristic of men who are reluctant to accept something as universally true and would rather discard a possible truth, than accept something as true, and find out later it was false. The separate knower would say, 'I can see those angles are equal, but how do I know that all angles in a similar situation are equal?'

Connected knowing, another stage, uses personal experiences to build up a perception of truth. The knower would question, but would want to know what circumstances lead to the conclusion. Authority to proclaim the truth of a statement would come from shared experiences, not from the domination of power or status. A creative process of co-operation would be used, not the deductive logic of the separate knower.

The connected knower would say, ‘I can see that those angles look equal, but what about others? Let's look at those too.’

The last stage is constructed knowing. In this phase, the knower constructs all the knowledge. She would integrate the active characteristics of the previous stages to deduce the required information and would give considered answers to questioners. She is prepared to tell questioners why she thinks a particular fact is so. She would say, ‘Let’s look at the angles together. Tell me what you think’.

Becker contends that the connected knowing stage is the crucial one for women. She says that if it is important for girls to know, and connected knowing is how they prefer to learn, then that is how they must be taught, in spite of the difficulties posed by such precise, logical subjects as science, mathematics, and technology. She acknowledges the possibly detrimental political implications of attempting to implement different ways of knowing, and that these differences may be used against women, but says that this possibility is the lesser evil. To ignore the differences is to deny a large section of the population a full range of career choices. This affects not only female students, but society as a whole.

The preference that girls show for collaborative learning is documented by several researchers. In *Learning to Lose*, Spender & Sarah (1980), include in their acknowledgments recognition of the group support and co-operation they received, and point out how feminist writers are exploding the myth that writing is done in isolation. Spender calls her chapter in the book 'Educational Institutions: Where Co-operation is Called Cheating', which illustrates how she sees current attitudes in schools towards shared activities. She discusses the concept of teaching/learning as a mutually active process, rather than two separate processes, where an active teacher gives out knowledge to a passive learner. This idea causes alarm among educationalists, who see it as a threat to teachers’ autonomy. Spender illustrates the concept further, by relating how feminist groups invariably work co-operatively, and how in this situation the traditional distinction between teacher and learner no longer applies. In the same book, de Wolfe (1980), in her chapter on 'Women's Studies',

discusses how the Women's Movement has always stressed the importance of shared experiences and co-operative learning.

The work of Johnson et al (in Underwood & Underwood, 1990:62), shows that co-operative computer activities rather than competitive games hold more interest for girls. They conducted a series of tests and found that the girls disliked a competitive environment, and did not perform as well as the boys. In co-operative activities, they performed better than the boys. They say that shared activities lead to more positive attitudes to computing, as well as to greater educational gains.

Selby & Ryba (1993), express the view that changes can be made within education to include girls, rather than exclude them, by adopting collaborative learning approaches. They say that the changes they advocate are based on documented research and theories concerning the preferred learning styles of girls. These changes have been shown to create improved computer learning environments for girls.

Nielson & Roepstorf (in Purdue, 1994:7), found that girls tended to gravitate towards each other, and that the human element seemed more important than the actual problem on which they were working. They seemed to work within an acknowledged group, and all were able to make a contribution.

What does all this mean for the classroom teacher? Asking teachers to change their basic teaching style to accommodate a vague, ill-defined need for girls to use prior experiences and knowledge in their problem-solving efforts, as suggested by Becker (1995), would perhaps be unpopular. Most teachers would need something much more clearly defined and more easily understood, both in the application and in the rationale behind the application. However, asking teachers to incorporate co-operative groups in their daily routines would be a welcome move in many junior classrooms.

Learning groups may need to exclude boys in order to give the girls the opportunities they need. This could lead to minor problems within the classroom, and possibly with some staff, and would need to be carefully explained. The focus in most schools is,

where it is appropriate, to ignore gender differences. Davies (1988) agrees with this, saying that any form of activity that is designed to differentiate between boys and girls should be abolished. However, when some form of affirmative action is involved, differentiation is necessary. She says that boys must be helped to see the necessity for girls to have space, and they may even be taught supportive techniques to assist girls in developing the relevant skills.

Purdue (1994), presents a list of recommendations that may help to make the computer accessible to all young children. He suggests that teachers implement collaborative learning approaches, such as co-operative learning, and peer tutoring. Selby & Ryba, (1994), have drawn up a similar list. It suggests allowing for co-operative or individual learning, and the discouragement of aggressive competition. Farmer (1992), suggests practising problem-solving and decision-making within a group. None of these writers considers whether the groups should be single sex or mixed.

McCormick (1994), discusses the benefits of co-operative learning for female students, saying that such activities allow them to express their female voice, and to integrate aspects of the male voice, such as decisiveness, leadership, and objectivity. However, she says that some researchers, notably Lockeed & Harris, (in McCormick, 1994:65) and Lakoff, (in McCormick 1994:65) indicate that co-operative learning may not be a positive strategy for girls, because of likely dominant behaviour of males in the group, and dominant male communication patterns.

Scott (in Grant, 1991, and McCormick, 1994:65), says that in order for girls to benefit, teachers need to: frequently use mixed gender groups, monitor problems, and teach specifically about the restrictions of gender stereotyping, and different communication patterns. This view agrees with that of Davies (1988) and again, highlights the issue of whether single sex or mixed groups are the most beneficial. It is possible that single sex groups would have a similar effect to the ‘girls only’ times mentioned earlier. Noddings, (in McCormick, 1994:65) and Lee & Bryk, (in McCormick, 1994:65), call for further research into cross-gender learning, and this seems relevant.

Members of women's organisations, who have found working in single sex groups so rewarding, would no doubt have opinions to offer.

Many researchers in this field consider that girls' interests and experiences should be given more recognition. One of the strategies for improved learning recommended by Selby & Ryba (1994), is for tasks to be tailored to suit girls' interests, as well as those of boys. Farmer (1992), suggests that technology problems should be presented in a context of human interest in order to catch girls' attention. Purdue (1994), says that software needs to be screened, and an attempt made to locate programmes that appeal to girls. Kenway (in Farmer, 1992:15) considers that the technology curriculum does not take into account girls' interests, strength, and knowledge. This aspect of technology education is the main theme of the work of Bell (1988), who is adamant that tasks need to be linked with girls' prior experiences.

Teachers could be made aware of the benefits of this approach, and it would not be difficult to implement the approach into the classroom. In the primary area it would depend on obtaining suitable software on which to base projects. 'Dinosaur Discovery' and 'Postman Bear' are two programmes which girls find interesting, and the painting programmes are generally popular. However, most games and programmes are boy orientated. Software manufacturers, mostly male of course, hold the key here.

The need for more computer literate women as role models is seen as important by many (Farmer, 1992; Selby & Ryba, 1994; Egan, 1990). However, in a detailed study supported by UNESCO data, Byrne (1990), found no correlation between the proportion of women teachers, and the numbers of female enrolments in any particular field of study. She labels this hypothesis as a classic use of deficit theory. Blaming women for the deficiency enables researchers to avoid the need to look further for alternative causes. She quotes a UNESCO report (1983), that claims there is no coherent body of theoretical knowledge on gender issues, and that many mistaken ideas still persist concerning women. She considers that there a need for more research into sex differences in education, and into the continuing sex bias in teaching and learning practices.

There appears to be no doubt in the minds of most of the researchers noted above that girls are disadvantaged in the field of technology. The most significant factor causing this disadvantage seems to be the different ways in which girls learn and relate to their world and its problems. The fundamental changes required to address these difficulties lie with educational policy makers, who then have the task of persuading individual teachers to implement these changes. Software manufacturers will alter the content of their products if the market demonstrates that is what it wants. As Selby & Ryba (1993) argue, the problems do not lie with the girls themselves, but with the social practices existing in their classrooms. Teachers as professionals have a significant role to play if we are to be fair to the girls.

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