CDT and Equal Opportunities

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For just over a decade the Equal Opportunities Commission (E.O.C.) has been employed in its task of ending sexual discrimination. Up until comparatively recently gender differences in education were thought to be a problem that co-education could put right. Since girls must be part of any social class or ethnic group, their advantages or disadvantages would vary with whatever group to which they belonged. Better opportunities for some groups would, therefore, seem to offer better opportunities for some girls. The issue of girls was thought to be part of bigger issues in society and education. Even though sex-role differences might have certain questionable aspects other matters had priority. But, gradually, with changes in the structure of the family and in the legal and vocational status of women there came a realization that equal opportunities did not seem to exist for women in society and education.

The Sex Discrimination Act of 1975 made it unlawful to restrict girls from studying subjects such as CDT and technical drawing which had hitherto been male-dominated. The E.O.C. points out single-sex schools should provide the full range of curriculum options (eg by allowing girls to attend classes in boys' schools) and their facilities should be no less favourable than those provided by any mixed-sex school in the same area.[1]

A recent report, specifically concerned with option choices, has stated that a few schools still restrict some subjects in defiance of the law and amongst the 97% of schools involved in the research which offered a rotational craft timetable many were badly implemented and so offered an inadequate experience base for pupils to make a serious choice.[2] Given that female involvement in CDT is relatively new, that only 1% of CDT teachers are female[3] and that the rotational scheme does not conform in many schools with the spirit of the law, it is not surprising that a low percentage of females study the family of design and technology-related subjects at examination level, or follow up their studies into a related career. CDT shares some of the problems of low female involvement found in mathematics and the physical sciences. Researchers have sought for explanations within biology, sociological theory and educational practice, though it is clear that the traditional ways of regarding and treating women cannot be ended immediately by legislation, and that such ways assumed a lesser and differentiated role for women. There are those who argue that as long as subjects are equally available to be studied by boys and girls, the school should remain neutral, leaving choices and options to pupil preference. Unfortunately you cannot break the traditional mould without doing something positive. It is not easy to give up the gender stereotypes that have controlled social practice in this matter. Gender differentiation is built into our schools, and with it goes the message that on average girls are not so good in maths, the physical sciences and CDT. Some argue that to change this message, to sponsor girls in these areas, we must help women assume some of the power which gives design and technology its structure and direction in society, and its form and content in school. In this paper I am attempting to offer an overview of the research and recommendations which are relevant both to CDT and to the principle of equality of educational opportunity.

1. Equality of Educational Opportunity

The principle of equality implies that there ought to be no differences of treatment between those who are equal in all respects relevant to the kind of treatment in question. To ask for equality is to ask for the removal of some unjustifiable discrimination or differentiation of treatment. But who is measured against whom, and what counts as unfair or unequal treatment, will vary from time to time and from social context to social context. To see yourself as being unfairly discriminated against, you must see others as possessing what you lack, deserve and want. You must, in other words, possess a certain social awareness, as well as a set of expectations which are somehow frustrated. Awareness and motivation are, similarly, two of the factors essential for inequalities of opportunities to be recognised. Opportunities are means to some goal or set of goals. To have an opportunity for something is to be eligible for consideration though with no certainty of successful achievement. Opportunities are 'given', so that this eligibility is made available, but it can only be taken up if one has the relevant potential, ability or talent and desire for the object of opportunity. In saying this, I am pointing out that there are external factors and subjective elements that turn something into an opportunity. Many school students may not see sixth forms as providing educational opportunity, because they may not know what is involved in further and higher education, they may not want the academic studies which are available or they may not understand and be able to take advantage of what is offered.

To say that there are equal opportunities is to say that a) i. there is no unfair discrimination against some group or individual and ii. that indeed chances are provided so that it is possible to achieve the desired goal, even though some process of selection has to occur. b) that any rejection of the opportunities occurs on rational grounds or at least personal choice. Within this latter condition a crucial distinction needs to be made. It may be that those who have the opportunity come to the settled conclusion that they genuinely do not want it. This we can call a rational decision. However, it may be that as the result of the socialisation process and the undue influence of others on one, the opportunity is rejected. At one extreme this will be a forced decision as when a youth leaves school because of immediate family pressure, despite possessing the necessary talent and being appropriately motivated. More subtle is the case when the values affecting the choice are thought to be the individual's own but are in fact the results of socialisation.

Girls may not see themselves as discriminated against, and even when others, feminists for example, insist that they seize their opportunities they may not want them. They may lack political ambition, the desire to compete in jobs with men or to become engineers. Part of the task of education is to develop the individual's awareness and motivation. It is for this reason schools cannot adopt a stance of neutrality.

More needs to be said about 'discrimination', which can be used negatively to imply treating a person, by

direct or indirect means, unfavourably on the grounds of some feature irrelevant to the matter in hand (eg on the grounds of sex), or positively to denote a deliberate policy to put right the negative discrimination or its effects, by offering special assistance to the disadvantaged group. If the position of women in society is to be improved, then we must consider ways which will allow them to achieve positions of responsibility and power, in proportion to their numbers and ability. This can be done giving them preference over men in competition, even though the men may be better at the particular task. Providing that the women are able to hold the position, this preferential treatment can be justified as a provisional measure, on the grounds that it will get others more used to seeing women in former male preserves and thus expecting more of them. The transient individual injustice is intended to prepare the way for greater justice between groups.[4] Less radical is the idea of providing special help in maths, physics and CDT for girls partly to compensate them for their relative lack of appropriate experiences and partly to assist the development of females entering into traditionally male areas of work and study.

2. Unequal Achievements at School and Beyond

Douglas in his 1971 longtitudinal study of 5000 pupils in primary schools stated: 'In the primary schools boys and girls are for the most part taught together in the same classrooms and their measured ability and attainments are similar. The girls, on the average, make rather higher scores than the boys in all tests, except for vocabulary at eight and eleven years. Their advantage was however slightly less at the older age. The primary school teachers assessed the girls as having a more serious attitude to their work and to being more satisfactory pupils than the boys, who were more often reported as restless and inattentive in class'.[5] Barker Lunn's survey of 2000 third and fourth year junior school children in the following year concluded that 'Girls at the primary school level make faster progress and attain a higher level of achievement', and suggested that the slighter effect of social class on girls' achievements compared with that of boys was due to the greater willingness of the girls to comply with school requirements.[6]

A technological emphasis in CDT requires the disciplinary tools of physics and mathematics; therefore it is important to consider the achievements of girls in physics and mathematics.

The APU surveys of primary and secondary mathematics showed that the boys at 11 years of age expressed more confidence than did girls in their own mathematical ability and had a greater expectation of success.[7] By the age of 15 the difference in achievement was most noticeable in the top attainment bands. Thus the proportion of boys to girls obtaining the highest 10% of scores on the APU concepts and skills tests was 61% to 39%.[8] However, there have been improvements in the percentage of females in the overall numbers of thos obtaining CSE Grade 1, 'O' and 'A' level in Mathematics between 1970 and 1984. Thus there was an increase in females as a percentage of those obtaining CSE Grade 1 from 35.6% in 1970 to 48.7% in 1984, at 'O' level from 37.5% to 43.8% and at 'A' level from 17.6% to 30.8%.[9] The UCCA figures for home candidates accepted to study the mathematical science subjects at undergraduate level at British universities in October 1985 shows females constituting 25.5%.

If CDT is seen as having a close relationship with physics and mathematics, then this picture of the falling-off of interest and achievement by girls in mathematics becomes significant. Research into the reasons for this notes that secondary mathematics requires the problem-solving, experimental approach, which it finds that boys have developed more than most girls.[10] Again this fact and its consequences may be significant for CDT, central to which is the problem-solving method.

The APU surveys on physics revealed the same picture as the mathematical surveys. Boys produced higher average scores than girls on more than 90% of the questions concerning the application of physics concepts at each age, and for half the questions the discrepancies reached statistical significance. Boys' superiority proves consistent across all the physical science concept/topic areas included in the assessment (force, pressure, speed, energy etc), although the discrepancy is particularly marked in the case of electricity at all three ages and at age 15 for light (refraction and reflection) work and energy, and planetary motion.[11] With a lack of achievement comes a reduction of interest. Once physics becomes optional, only 1 girl in 5 studies it, compared with 3 in 5 boys. It is not therefore surprising that the examination results, even though they show an improvement over the last few years in girls' performances, remain poor. Thus girls as a percentage of CSE Grade 1 increased from 6.2% in 1970 to 20.8 in 1984, of 'O' level from 20.9% to 27.6% and of 'A' level from 16.7% to 21.0%. In contrast biology passes for girls in 1984 was for CSE 65.8%, for 'O' level 60.5% and for 'A' level 59.5%. The UCCA figures for candidates accepted in October 1985 for the Physical Sciences show a female percentage of 24.5. For the subject of physics the percentage was merely 15.5.

Given this general picture in mathematics and physics of a reduction of female interest and achievement, the relative newness of CDT for girls and the traditional absence of females in areas of craftsmanship and engineering it is not surprising that boys do much better than girls in CDT at 'O' and 'A' levels.

If we take the figures for 1985, females as a percentage of 'O' level passes in England constituted 5.74% of design and technology, 6.3% of technical drawing, 1.63% of metalwork and 1.68% of woodwork. They constituted 2.9% of 'A' level metalwork and woodwork, 3.4% of technical drawing, and 8.2% of other science and technical subjects. UCCA figures for candidates applying to do engineering and technology degrees at university in 1985 show a female percentage of 8.5%.

As a whole females constitute 41.6% of the home undergraduate population at British universities in 1983/4, so it is clear that the polarization between 'male' and 'female' subjects and activities which began at puberty continues into higher education and work. For the total British university population in 1983-4 females constitute 69% of Education, 70% of Language, Literature and Area Studies, 53% of Arts and other languages, 48.4% of Medicine, Dentistry and Health but only

9.2% of Engineering and Technology students.[12]

This disturbing picture of gender differences in academic life is replicated in the world of work. The overall proportion of women in paid employment is 39%, of whom 64% are married. The occupations in which they are engaged are of more limited categories than those in which men are engaged, principally covering clerical, service and sales. Whereas 91.8% of the nursing profession are female, only 9.7% is involved in science, engineering and technology. Michael Webb in his survey of the labour market in Britain argues that the segregation of the labour force — with males predominantly in certain occupations and females in others is due either to the way each sex is socialized and educated before entry into the labour market, or because there are discriminatory procedures operating in the labour market itself.[13]

In summary, then, we have seen how girls are slightly ahead of boys at the primary stage of education. However, a significant polarization of interests and achievements occurs at the secondary stage with girls tending to take languages and the arts, and to fail to sustain interest in mathematics, physics and technical subjects. By 'A' level and university the differences become greater. In work there also tends to be a great contrast between male and female occupations, with a small percentage of women in jobs that might seem to be related to the areas of craft design and technology. Does the explanation for this failure of females in the physical sciences and technology lie in biological factors, our culture or in our schooling? What implications might the answers have for the organization and teaching of CDT?

3. Inateness, Visual-Spatial Ability and Graphicacy

Maccoby and Jacklin in their authoritative analysis of the research on the psychology of sex differences conclude that only four things are fairly well established: that girls have greater verbal ability than boys, that boys excel in visual-spatial ability and mathematical ability and that males are more aggressive.[14] Of these factors the most significant from the point of view of CDT and graphic communication is visual-spatial ability, though it must be noted that the female superiority in verbal skills is often overlooked in science and technology classes.

Central to visual-spatial ability are the capacities to perceive the visual world accurately, to transform one's initial perceptions and to be able to re-create one's visual experience, even in the absence of relevant physical stimuli. It is the ability to visually manipulate objects in space. Such an ability seems to have been well-developed in Einstein, is of central importance in the chess master and would seem to be essential in the capacity to design. Gardner argues that since hunting and wandering were preeminently male preoccupations requiring a heightened sense of spatial ability, there would be more of a selective advantage for males to evolve highly developed visual-spatial abilities and more likely an early death for those who lacked such skills.[15] Studies have shown that this ability is influenced by a sex-linked recessive gene, which males are more likely to express. Some researchers have argued that hormones affect spatial ability, so that the presence of androgen is related to the presence of spatial ability, yet others have estimated that 50% of men and 25% of women have a special ability gene.[16] The APU studies showed a number of performance weaknesses in physics tests which could be attributed to spatial ability differences between boys and girls.[17] However Fennema and Tartre, in studying the relationship between mathematical performance and visual spatial ability, concluded that while it may help explain sex-related differences in mathematics 'one must never say, think, or most of all, believe that all girls are less able than all boys to use their spatial visualization skills appropriately in mathematics . . . too many people believe that large differences between the sexes exist where they do not'.[18]

There are problems in ascribing group differences to innate biological factors. Thus it is not at all easy to prove that what is tested is nature without nurture. Statements about average variations between the genders cannot totally be separated from social factors. The fact that Eskimo females are relatively high on spatial ability seems to be related to their cultural needs and opportunities. However, even if it could be shown that girls are innately less spatially able, it would not then follow that they should be less involved in activities using such abilities. It is true that this may mean playing on their weakness, but with the right opportunities most people can improve on their native talent. Thus there is a case for giving girls more visual-spatial experience and boys more verbal experience.

This is not to deny that one's body chemistry does not have a major influence on one's behaviour. The fact that castrated males of all species are more docile and tractable seems to point to aggression as being an effect of male hormones. However, what is unique about humans is their capacities within certain social contexts to control and modify their tendencies. It may be that the characteristics we term 'feminine' have arisen because of woman's central role in bearing and nurturing children. Our society has certain sex-role stereotypes, which cause us to assume that girls are distinguishable from boys in mannerisms, attitudes, behaviour and dress. While some of the features may be based on natural differences, others have arisen historically from certain social decisions. Changes in society lead to changes in social role. Thus contraception and technological innovation have dramatically changed the life of the young married wife of today. The fact that the woman need not be tied to the home affects our attitude towards her role. We can have some say in deciding what characteristics we want to develop in our children. Equality does not imply that we ought to develop boys and girls to have the same personality profiles. There are social, moral and political questins that need to be asked, and we need to be more conscious in society and in school of what kinds of individuals we hope to produce. Human nature is a product of biology and socialization.

4. Sex Role Socialization

Sex role socialization is generally thought to occur in two ways by gender differentiation and by identification. Most theories give a central position to parents as the transmitters of sex roles. The parents' attitudes are often reflections of their own socialization, so the process of change is slow. From the process of naming, differentiation

between what is appropriate for boys and girls is built into the family relationships. The child comes to develop a grasp of what it is to be a boy or a girl. This understanding is built within the emotionality of the family, which itself reflects sex role distinctions and provides opportunities for identification and modelling.

Outside of the family, peer-group relationships are important in shaping attitudes and accentuating stereotyped features of sex roles. The games that are played, and the values that are mediated through the peers are strong even in childhood, but in adolescence the group becomes a major source of modelling and seems to provide a pressure for the narrowing of goals on the part of many girls. Many studies have discovered that teenage girls envisage their future in terms of marriage and family commitments as well as employment, whereas boys think only of careers — and a wider more challenging range of careers at that.[19]

Other important repositories of sex role standards are toys, television, books and people in public life. From these it is suggested that children construct a picture of what is a norm for their gender. Attitudes towards science and technology, it is argued, begin in early childhood. Studies have shown that boys tend to receive more creative toys, including scientific kits. In one study Torrance found that by exposing young girls to scientific toys over a period of a year, the girls' reluctant attitude to the toys and their skill deficiency relative to the boys were significantly improved.[20] It has also been suggested that boys in our culture tend to develop their spatial ability through playing with trucks and building blocks, whereas girls may develop their verbal ability more because they are encouraged to read or to be involved in less physical and more passive activities than the boys. One study suggests that encouraging reception class girls to imaginatively construct cars and space ships out of Meccano and Lego might help them feel more at home with science and engineering.[21] In a USA national science survey of nine-year olds researchers found that 10% more boys than girls claimed to have worked with batteries and bulbs, magnets and with floating and sinking. The APU survey of eleven-year olds showed the greatest discrepancies between boys and girls with boys fond of 'tinkering' activities such as making models, taking things apart, playing with electrical toys and playing billiards, while the girls said they cooked, knitted or sewed and collected wild flowers. The APU study claims that the model-making and billiards playing are likely to develop visual-spatial ability in the boys. They see all the discrepancies between the boys and the girls as significant, and all are in favour of boys.[22] The GIST project (Girls into Science and Technology) similarly reports that by far the largest sex differences they noted was in tinkering experiences, with boys having much more experience of using tools such as a saw or screwdriver, helping to maintain a car or bicycle and playing with constructional and electrical toys. As a result of their realization of this fact, they suggested to schools that they offer compensatory play sessions in which girls could catch up with these activities.[23]

Clearly the differentiation of activities together with the experiences they provide and the interest they engender are significant to the CDT teacher. Since it is a long-established educational principle that you start from the level of experience, interest and understanding of the child, opportunities ought to be provided for those lacking particular relevant experiences so that they can develop their attitudes, skills and self-confidence within these activities.

5. Gender and Schools

There are a number of ways in which sexual differentiation and the promoting of sexual stereotypes operate in school: a) segregation and the division of labour, b) the content of pictures, posters and textbooks, c) the curricular division of subjects, d) classroom practice, e) teachers' attitudes and f) careers advice.

a) *Segregation*: Schools segregate pupils in many ways. Most schools tend to separate boys and girls for P.E. (though less now in primary schools), and the DES report of 1975 even noted that a few middle schools separated the sexes for art, music, rural science, technical drawing and even for religious education. Changing rooms, cloakrooms and even playgrounds may be segregated and boys and girls are commonly listed separately on the register and lined up in separate groups.[24] These organizational arrangements are taken for granted though it is difficult to see how they can all be justified. They are supported by a division of labour in which boys are asked to move chairs or lift objects while girls are encouraged to look after younger children or make tea for visitors. The E.O.C. offers a check list for schools to judge their practice in these matters.[25] It is maintained that these divisions of activities help to contribute to gender stereotypes, a thesis that may be plausible but is hard to prove directly.

b) *Books*: Lobban in research reported in 1974, found, within six common reading schemes, very clearly defined sex roles for adults and children. Male characters were nearly always dominant with feminine behaviour being domestic, passive and expressive.[26] A more recent study on maths text books concludes that they tend to define maths as the province of males. 'Individual examples of behaviour, briefly and starkly presented, accumulate as one works through the books into highly stereotyped images of males and females with little of the blurring and elaboration that may occur in a longer narrative'.[27] If one encounters gender stereotypes in a variety of sources, some hidden, others explicit, the pictures presented will be regarded as the norm. It is argued that gender self-attitudes are constructed in this way. However, it may be contended that studies of pornography and violence have not yet proven that violence or sex portrayed in books, plays or film stimulate such behaviour. The argument here suggests that gender stereotypes are much more all-pervasive than the presentation of violence and sex, and as such we should check whatever examples and illustrations we use that employ them.

c) *Curricular Division*: A 1975 survey noted that 98% of co-educational schools segregate boys and girls for some aspect of their work.[23] More recently the research on option choices concludes that the gender pattern of choice has changed little since the Sex

Discrimination Act. This is partially a problem of pupil preference partly that of school organization. As a matter of fact, the chances of a girl, who opts for the sciences, taking post-science-school-science course is less than that of a boy who has not studied science.[29] However, schools operate against both the spirit and the letter of the law. Thus a few schools still restrict some subjects to one sex (an example of direct discrimination), while others make it difficult for girls to choose craft because of the linking of subjects (indirect discrimination).[30] Many option schemes reflect the school timetable rather than pupil interest. The rotational craft timetables are often badly implemented, and involve short and unconnected areas of study which fail to bring pupils up to level of experience for genuine choice. In an abbreviated form they represent only a token gesture to the law. Schools should check their option schemes for any sign of them reinforcing traditional choice and stereotyping of activities.

d) *Classroom Practice*: Despite the reputation women have for talking, evidence on mixed-group discussions indicates that the males dominate up to two thirds of the conversation. Analyses of mixed groups interaction in schools, have described boys as more active in the classroom than girls. They both initiate more and receive more teacher initiated contacts. They are asked more questions and contribute more to classroom discussion. They receive both more praise and more criticism than girls. They are more self-confident and are more likely to call out or make unsolicited comments. These conclusions have been drawn from many observations of formal classroom lessons, though, of course, whether they are borne out in particular lessons or not depends upon the particular teacher, group and lessons. Research, however, reported to the British Education Research Association Conference in 1985 by Gay Randall showed that in a limited study of CDT workshop activities involving project work, girls had more contacts with the teacher than boys did and that girls' contacts were longer. Girls also interrupted more and made more unsuccessful attempts to initiate contact. Gender differences remained, but perhaps because of the less formal nature of the lesson and of the greater ignorance of the girls, contacts to gain understanding being of a private nature, were easier to achieve. Other studies differ from this in their findings. John Catton in a follow-up to the GIST study, states 'Not only do boys monopolize tools and equipment in CDT but they frequently take far more than their share of another major resource — the teacher's time and attention. This is evident in an analysis of 37 separate observations during the GIST project'.[31] Catton and others have noted that often teachers use their time with girls differently than they do with boys — they become patronizing and even do the work for them. This may also be observed when boys insist on helping girls who have difficulty with some piece of work. These findings are important in providing a check for the teacher. Is more attention paid to the boys? Are girls treated more patronizingly?

e) *Teachers' Attitudes*: Many different studies have shown that teachers' attitudes have a considerable influence on role expectations. Buswell in a number of case studies shows that male teachers' attitudes to boys and girls were often different, in that boys were given extra chances over girls and their lack of achievement was explained by a lack of effort rather than a lack of ability.[32] She argues that several ideas of what is a female are transmitted — so that most girls learn to fit into whatever nurtured, acquiescent or invisible categories are expected. The APU Mathematics Survey quotes research suggesting that males account for their success by ability and their failure by lack of effort, females account for their success by luck and their failure by weak ability.[33] These attitudes were reinforced by the teachers of Buswell's study.

Pratt's research found that staff did not wholly support the principle of equal opportunities. A considerable number of teachers believed that bench and technical subjects are more appropriate to the education and career needs of boys than girls. 40% of male teachers and 30% of female teachers believed that boys should be given preference in technical subjects. Few option booklets made positive attempts to encourage a choice that is non-traditional, and within the craft subjects there was a strong conservatism noted. 'The introduction of design and technology courses rather than traditional crafts in some case study schools allowed a widening of opportunities for both sexes, but was often greeted with hostility by some members of staff'.[34] This is the most disturbing finding yet, for it indicates that those girls who are interested get little or no support from teachers most expected to give them help.

f) *Careers:* The GIST report in an analysis of questionnaire responses of over 2000 Manchester children found the five most common expected occupations for girls and boys as follows: 1) *girls* — hairdresser 17%, nursery nurse 15%, typist 14%, nurse 11%, teacher 9%, 2) *boys* — armed forces 13%, engineer 11%, something in computers 11%, electrician 10% and car mechanic 10%. On the basis of such ambitions it must seem that CDT is less vocationally useful to girls than to boys. Both boys and girls agreed that three factors predominated in their choice of options a) usefulness in getting a job b) finding the subject interesting and c) their own performance in it. In both physics and CDT the girls tended to lack self-confidence and to underrate their own achievements. Three responses need to be made to this finding and others like it: i) It needs to be shown that science and technology are vocationally useful in a wide range of jobs. This is where the E.O.C. is helpful,[35] and Whyte offers a valuable list of careers and required qualifications in this area.[36] Career talks by successful female designers and engineers, as employed in the GIST project, are also likely to be helpful since what girls need is an awareness of the opportunities and difficulties females are likely to encounter.

ii) Option choices are affected by interest. There is evidence to show that females are more interested in the social uses of technology than are males. The APU research on physics showed that already by the age of 11 and younger boys show a greater enthusiasm for finding out 'how things work', with girls rather more interested in the issues of health, the human body and the aesthetic aspects of weather, colour and music. By the age of 15 the research

shows the majority of boys are interested in space exploration, satellite communication, cable television, robotics, nuclear power and atomic weapons whereas an even higher proportion of girls were interested in cancer research, heart transplants and test tube babies.[37]

The GIST report suggested four ways to make science more 'girl-friendly' 1) removing any masculine bias in the form of illustrations, language and examples: 2) linking work with other types of activity which girls enjoy e.g. discussions and creative writing; 3) emphasizing the application of the subject to everyday life *before* introducing difficult ideas, concepts and theories; 4) starting with topics familiar and interesting to girls. Perhaps the need to have design and technology projects across the curriculum would help pupils to understand and evaluate these areas in different ways and from a variety of disciplinary view points. Black and Harrison argue that technology is in danger of being given a narrow interpretation with a number of technologies being ignored such as fibres, clothing, food production and processing, nutrition, biotechnology, environmental control, medicine, traffic, urban design and the chemical industry.[38] It seems then that there could be a number of modifications to the CDT syllabus to make the subject more girl-friendly. Catton offers some examples of topics tht have appealed to girls and boys,[39] while Platt recommends that examination boards should ensure that syllabuses and papers reflect the experiences and interests of both sexes by realising the educational potential of the subject; this includes the understanding and resolving of human and environmental problems.[40]

iii) One way to increase girls' self-confidence in CDT would be to set up a technology club for girls or to establish single-sex teaching, if only for a short period of time. Research has often shown that girls were academically more successful in single-sex schools when they faced no interruptions from boys. Dale in his authoritative study of co-education concludes that the progress of boys is probably improved by co-education, while that of girls is not harmed,[41] though he does admit that the girls appear to have a decreased interest in physics and maths in co-educational schools.[42] there are no doubt social benefits to be derived from co-education but as Spender[43] and Harding[44] argue there is a case for at least some provisional groups of single sex teaching. The GIST team encouraged technology clubs for girls but noting that such clubs, despite pressure from the project team, rarely achieved double figures, concluded that this seemed to be due to the reluctance of many teachers to positively discriminate in favour of girls. Millman in her Coventry research with 3rd Year technology groups reported that boys tended to dominate the proceedings in mixed groups.[45] They brought with them a leisure interest in technology not shared by the girls and showed greater interest in the possibility of a technological career. Millman believed that, from the girls' viewpoint, single-sex groups were more successful because the girls' difficulties and needs were not concealed as they were in mixed groups. In mixed groups the less confident girls often found the boys did their work for them. It should be noted, however, that many mathematics and science teachers who formerly believed that single-sex groupings would benefit girls now have serious doubts about the strategy. Some feel that girls could be regarded as second-class pupils, others have felt that discipline is adversely affected and yet others have seen it as opposed to the spirit of co-education. One recent piece of research on first year science amongst some 2900 children in the South West of England concluded that there was no advantage in teaching children in single-sex science groups in mixed schools.[46] Bearing this in mind and also to avoid the charge of discriminating against boys in having technology clubs for girls alone, it might be wise to employ single sex groups as remedial for short periods of time only.

Studying and pursuing careers in science and engineering elsewhere. In East Germany in 1975 female percentages of those being trained to be electrical engineers were 59.5%, electronic engineers 44.5%, chemical engineers 69%, and mechanical engineers 43.3%. This gives a lie to those who see female occupations as being related to their biology. However, McAuley in an examination of the situation in the Soviet Union, concludes that despite increased investment in female education, inequalities between the sexes still exist. This can be ascribed to the fact that the sexes study different subjects at the higher level and that men are more likely than women to receive vocational training.[47] His analysis leads to similar conclusions that we have drawn here. The differences in attitudes are a reflection of differential socialization pressures, attributable to education, the home and society.

6. The Prospects for Girls in CDT

The prospects for girls in CDT and design and technology careers seem to be poor. The stereotypes which supply a set of norms of gender appropriateness are all-pervasive in society. Optimistic findings have to be set against others less hopeful. Thus one study following the GIST project discovered that most parents want their daughters and sons to study broadly the same subjects at school and they generally rejected the idea that boys' education was more important than girls. But overall they still retained a strong sense of sex roles in the home and appropriate but different careers to be taken up. For parents, it was concluded, 'equality is a little something extra, which can be added to existing social arrangements'.[48] It has been argued here that the differentiation of activities and the stereotypes children encounter seem to affect their own interests, ambitions and achievements. This message has to be transmitted to parents, publishers and television producers so that we are given a different set of pictures of what girls can do.

Teachers also have to change their differential expectations of boys and girls. This is a tremendous task, made more difficult by those who are committed to the traditional expectations of boys and girls. But it must be realised that what is being attempted is an awareness training by which females come to realise that in science and technology they can be as successful as males. Where delicate manipulations and finely coordinated movements are required, as in electronic work, they already seem to be slightly more able than men. If design and technology can be built more around their interests and if they can be given the opportunity to develop visual-

spatial ability and 'tinkering' experiences, their attitudes towards technology may change. The FEU project report on women and science and technology gives four main reasons why it is important to encourage females into technological and scientific careers: 1) they constitute a large source of almost untapped potential, 2) there is a shortage of qualified personnel in these areas (this includes physics and CDT teachers), 3) job opportunities in traditionally women's occupations are receding faster than in many other employment areas, 4) women and men have, as individuals of equal status in society, the right to fulfil as equal a role as possible in all aspects of working life.[49]

The report into CDT teacher training found that many of the female CDT teachers did not share the same set of background experiences and qualifications of their male colleagues. Their entry to CDT teacher training was often through indirect routes and they had to make an effort to overcome a lack of a school background in the subject. But they were helped in their concern by the encouragement of friends and support from parents, especially fathers. Encouragement from CDT teachers and involvement in relevant hobbies were also relevant.[50] The FEU report on women and science technology discovered three main factors about females involved in science and technology in further education: 1) they were individuals who wished to do something out of the ordinary, 2) they were motivated by good science teaching at school and 3) they were influenced by a friend already involved in science and technology.[51] If modelling is important, as studies on role socialization suggest, then there is a need for appropriate female role models in CDT. This can be best done through increasing the supply of CDT female teachers. However, as the EOC report indicates, this is easier said than done. At the very least, colleges and universities need to participate in a national promotion campaign. For this, they need to establish links with secondary schools, encourage visits from girls and provide taster courses, improve the access of mature students with less orthodox qualifications and encourage CDT in primary education. The task is enormous. But the influence of female CDT teachers on courses and girls could be valuable.

Two final points need to be made. It is still vitally important to raise the status of the subject by doing whatever we can in our various institutions to show the richness of the subject. One way of accomplishing this is by ensuring that the subject becomes part of the common core in schools, with the various elements united. It is sometimes said that the high proportion of East German female engineers is due to a compulsory curriculum and a controlled labour market.[52] The research on option choice concludes an examination of what had been observed in physics by stating 'The school most successful in getting a majority of girls to study a physical science at 16 had a core curriculum science programme'.[53] Of course as I have indicated throughout much more is needed than more CDT. There needs to be changes in classroom practice, more cohesion in the total CDT programme, more positive attitudes towards girls taking CDT, some

provisional teaching for girls only — and so on. As I said at the beginning, for there to be equal opportunity there must be awareness and motivation. This requires a massive change in attitudes.

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