From the Woman Question in Technology to the Technology Question in Feminism

Rethinking Gender Equality in IT Education

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ABSTRACT There have, by now, been a number of thorough-going critiques of what has variously been called the 'equality', 'equity' or 'liberal' approach to understanding 'the woman problem in technology' by those who would prefer to focus on 'the technology question in feminism'. Most of these critiques adopt deconstructivist techniques to expose the limitations of equality approaches, including, most centrally, their assumptions about the neutrality of technology and the limited nature of equality programmes designed simply to increase access for women to that technology. However, the critiques themselves have so far failed to come up with convincing alternative interventionist strategies, either because the universalizing tendency of their theoretical perspective gives rise to interventions that fail to deal with the diverse and fragmented nature of women's experiences and needs, or because recognition of this diversity and fragmentation leaves very little common ground on which to build successful intervention strategies. This article addresses this dilemma in the context of computing and IT education and draws on empirical research on women's experiences of computing and IT in two different educational settings where issues of gender difference and equality were managed in very contrasting ways. It then offers some suggestions for how both a critical and constructivist discourse on technology might be made to coexist in educational programmes designed to promote gender equality.

KEY WORDS computing ◆ education ◆ equality ◆ gender ◆ technology

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GENDER, TECHNOLOGY AND EDUCATION

Given the falling numbers of women entering computer science at tertiary level over the last 20 years, it is not surprising that much of the research on gender and computing education to date has been driven by the desire to increase access for women to computer education, whether in schools, further or higher education (Dain, 1992; Morton, 1986; Sears, 1991). However, much of this 'access' literature has tended to work with very limited, and therefore limiting, understandings of technology, of gender and of equality, which rely, for the most part, on liberal discourses which incorporate a determinist model of technology and a deficit model of women and girls.

In these accounts, technology (here, computers/computing) is understood, rather unproblematically, as neutral, as simply a set of skills to be acquired. Commentators may advocate 'compensatory strategies' such as making it easier for women to 'choose' this area of study by promoting a more feminine image of computing but they tend not to question the technology as such, which is perceived, in purely technical and neutral terms, as a 'given'.

Furthermore, in these accounts, women and girls are often perceived as being somehow in deficit, as needing to 'catch up' with men and boys by gaining access to this set of technical skills. Gender differences in relation to technology tend not to be addressed head-on, but the implicit understanding of such gender differences is that they are largely 'added on' and can be overcome by offering women the same opportunities as men. Here, then, gender is just a 'social distortion' underneath which there is a more neutral attribute – 'humanity' – shared by men and women alike.

Thus, in liberal discourse, masculine computing and computer images are understood as cultural misrepresentation, and gender as social or cultural distortion. Underneath such distortions exist neutral technologies and equitable human relations free of gender. Educational curricula, too, are often understood in such neutral terms. For example, the term 'hidden curriculum' is commonly used to label what are considered discriminatory practices within an otherwise neutral educational philosophy (for critique, see Arnot, 1995; Bernstein, 1990).

As many commentators have pointed out, there are serious problems with liberal discourse and its associated 'equal opportunities' practices in the gender and technology field (Grint and Gill, 1995; Henwood, 1993, 1996; van Zoonen, 1992). In relation to education in particular, any such changes to the computing curriculum will necessarily be limited in that changes must not be seen to be offering anything special to women as women because emphasis on women's difference from men is seen to undermine calls for equality, which is understood, in very limited terms, as sameness (Henwood, 1998). Similarly, such changes must be aimed only

at finding ways of attracting women to technology as it is currently constituted and must not seek to explore, understand or challenge that constitution. Thus, apparently straightforward access and skills acquisition become the focus for liberal intervention in this field.

In addition to having a narrow understanding of the 'problem' of women and technology and, hence, a narrow set of 'solutions' to that problem, such approaches take little account of the potential for resistance to such interventions. Resistance may take many forms but existing research on women and technical skills suggests that such resistance may be related to the perceived threat to masculinity and dilution of status when women enter a technical field (Cockburn, 1983; Hacker, 1989, 1990). Indeed, I have suggested elsewhere that this threat may explain the constant reassertion of gender difference in discourse, a process that often inhibits women's ability to speak of the contradictions they face in technological subject areas and, at the same time, hides from view the social and cultural context in which gender is actually being produced (Henwood, 1998). Furthermore, it should not be forgotten that resistance may also come from women themselves who resist such compensatory strategies precisely because the changes to the curriculum that are made to 'bring women in' so often reinforce women's 'non-technical' identity.

In contrast to this liberal approach are the more constructivist accounts of gender and technology relations. These are less concerned with 'getting women into' technology than with understanding why and how women are so often excluded, why technology has come to be perceived as 'masculine', and how we are to understand and make sense of those that do enter technological education and occupations. In this literature, neither skill nor technology are understood as neutral. Many feminist commentators have explored and exposed the ways in which, historically, male workers have managed to have their work defined as skilled, even when the content resembles women's work, which is invariably defined as unskilled or semi-skilled (Cockburn, 1983; Game and Pringle, 1984; Phillips and Taylor, 1986). In this way a hierarchical gender structure is reproduced in the workplace, with men's work carrying more status than women's. Furthermore, Cockburn has shown how technology and technical skills are implicated in the very construction of gender identities so that it has become widely accepted, though not empirically proven, that men are good with technology whereas women are technically incompetent (Cockburn, 1985; McNeil, 1987). Thus, in dominant discourse, gender is symbolically constructed, in relation to technology and technical skills, in oppositional terms, so that the acquisition of technical skills by women is perceived by many as a threat to the masculinity of men and to the gender order more generally. Following Harding's early work on gender and science (Harding, 1986), gender and technology relations have now largely come to be understood as being produced at three interacting

and usually mutually supporting levels: the structural, the individual and the symbolic as the academic debate has largely made its transition from 'the woman problem in technology' to 'the technology question in feminism'.

Despite this shift in our understanding of gender–technology relations, there are few interventionist strategies that appear to take on such insights. In education, a potential and obvious site for innovative change, initiatives vary from the liberal to the more overtly feminist where girls and women are assumed to bring different experiences and 'standpoints' to bear on questions of technology. However, rarely do such initiatives seem to go beyond the inclusion of more 'girl/women-friendly examples', which themselves have a tendency to universalize the female experience in ways that alienate as many as they embrace.

In this article, I draw on empirical research[1] which focused on the experiences of two groups of women studying on computer courses in UK higher education: one, a traditional computer science (CS) course, employing very liberal notions of equal opportunities, and the other, an interdisciplinary information technology (IT) course which, I argue, embodies some aspects of constructivism in its approach to the gender–technology relation. How do women actually fare on each of these courses? What are the dominant discourses of gender and technology on each course and how far is the binary opposition of masculine–technical, feminine–non-technical inherent in such discourses? How do these discourses vary across courses and what positions are held by staff and students in relation to these constructions? How far are dominant constructions accepted and how far are they resisted and with what implications for the individuals concerned and for future gender equality programmes in education?

Research to date has (almost universally) found that women are more attracted to computer courses that emphasize social issues and computer applications than to traditional science-based computer courses (Siann, 1997: 115). In terms of numbers alone, our research would seem to support this contention. Women constituted just 20 percent of all CS students but over 50 percent of interdisciplinary (ID) students. In addition, women appeared to fare well, in terms of formal outcomes, on both courses, but especially well on the ID course. However, in this article I want to argue that, in attempting to assess the extent to which dominant gender constructions can be resisted or overturned, attention must be paid not only to formal outcomes such as pass rates/results/grades, but also more informal outcomes, including perceived levels of competence and confidence among the student groups. It is in assessing these levels of competence and confidence that it becomes clear how these relate to the extent to which students are able not only to acquire technical skills and thus achieve status within the hierarchical structure of technical skills, but to own that acquisition at a more subjective level, as part of their overall identities. I argue

that it is this process – the 'internalization' or 'ownership' of technical skills – that is inhibited by their continual exposure to symbolic constructions of gender–technology relations that offer women only marginal or outsider status within technological cultures. I conclude by arguing that it is precisely by exploiting this tension between the structural, the individual and the symbolic aspects of gender that a productive starting point for deconstructionist approaches in IT education can be found.

COMPUTER SCIENCE AND ID INFORMATION TECHNOLOGY: A TALE OF TWO CULTURES?

The two courses examined were both taught in the new university sector in two different universities in London in the early 1990s. The research sought to compare women on a conventional CS course with those on an interdisciplinary programme, in terms of their experiences of the process of technical skills acquisition and the relative success of that process in these two very different contexts or 'cultures'. The conventional course was chosen as representative of the type of computing course few women currently choose and which is often experienced as problematic by those that do. The course was part of a programme of degrees taught within a Faculty of Science and Engineering, in the School of Computing and Information Systems. Students on all these degrees followed a largely common 'foundation' programme in their first year and from this foundation programme, we chose to focus on a module that sought to introduce students to the principles of data structures used in programming. The interdisciplinary course was chosen as indicative of a course that deliberately set out to attract women students by combining technical skills acquisition with an exploration of the social, including gender, relations of technology. The degree was taught within the Faculty of Social Sciences and comprised core and optional modules, which between them offered IT skills and contextualizing studies that sought to locate and understand technologies historically, culturally and economically and with particular reference to the students' chosen specialism: education, media and communications, social research or women and technology. Again, the students followed a common 'foundation' year and from this, we chose an introductory IT module on which to focus for our study.

Thus, the participants comprised two groups of students, studying computing in two very different contexts or cultures. We chose to focus on small groups rather than on the whole cohort for each course because we were interested in using observational and in-depth interviewing techniques (in the ethnographic research tradition) to try and understand these two cultures and these women's experiences 'from the inside', a methodology that is unworkable with large numbers of participants. The CS

group had 16 students in all, of whom five were women; the ID group had 12 students in all, of whom five were women.[2] A combination of questionnaire and interviewing techniques was used three times throughout the period of study to gather background data on the students, their reflections on the process of acquiring technical skills and on the outcomes of their study. Other data were collected via observation in workshops and seminars, examination of course documentation (validation documents, course handbooks, module handbooks and worksheets, assignment guidelines, etc.) and interviews with relevant members of staff including, where possible, those responsible for admissions, course management, module development and teaching.

How far, then, was the binary opposition of masculine–technical, feminine–non-technical in evidence in our two courses? In what ways was this opposition reproduced in discourse and practice and with what implications for female students' understanding of their own progress and outcomes? How was equality defined on each course and how does this definition fit with understandings of gender difference? I was interested in the question of whether, where women were able to acquire technical skills and, in a formal sense, have positive outcomes (pass rates, marks, etc.), it would be more difficult in some contexts than in others for them and others to recognize their skills and for them to display confidence in line with such skills acquisition. Would there, for example, be a tension between dominant discourses of gender and technology which reproduce these binary oppositions and the women's own experiences, which might suggest a greater diversity of experience? Would such tensions be more obvious on the traditional computer science course, closely associated with conventional masculinity than on the interdisciplinary course where alternative discourses are promoted as part of course philosophy? Would there be greater opportunities for resolution of such conflicts on the interdisciplinary course?

Gender and Technology: The Dominant Discourses

There were significant differences in the ways in which computing and technology were understood on the two courses. On the CS course, computing was defined in fairly narrow terms, in relation to professional and industrial requirements where each of the degrees will: 'respond to the needs of industry in providing education that is relevant and at an appropriate state of the art [and] graduates from the scheme will continue to find a ready acceptance in industry' (CS validation document). In addition, in all the CS publicity material, considerable emphasis was placed on stressing the technical facilities of the university and the specific programming languages the students will learn (Modula 2, C, Ada and PROLOG). Acquiring state-of-the-art technical skills was presented as the

desired outcome for CS students who seek to become professionals in the computer industry.

In this discourse, the 'social' remains, typically, separate from the 'technical'. For example, one tutor described the course's approach to systems design:

> We look at the practical issues in an organisation, but as a systems analyst you don't get involved with the political, you can't, you have to be sensitive to them but also objective and don't go beyond the scope of your brief, you can't make recommendations outside of it. (course tutor, information systems engineering)

In contrast, on the ID course, computing was understood in much broader terms as a technology or set of technologies that comprise technical and social aspects. For example, the ID validation document described the course as adopting 'a new approach to undergraduate education concerning technology', one in which students are encouraged to 'contextualize' new technologies via an interdisciplinary approach which understands such technologies as innovation processes in which 'social, political, cultural, economic and technical factors are interwoven'. The user is visible within this course, where great emphasis is placed on the evaluation, as well as the construction of technologies. The degree was designed around options areas that largely reflect applications areas for IT: notably media, education and social policy to ensure that technologies were evaluated in the context of their use and with user needs and requirements always in focus.

Thus, the two courses were very dissimilar and may be thought of as representing two 'cultures of computing', one, a typically science-based computer course, designed to produce state-of-the-art, academically qualified and technically skilled graduates who can take their place with others working in the computer industry; the other, a more social science-based computer course designed to produce technically skilled users and evaluators of new IT designs and applications, with emphasis on the generic, as opposed to the specific, technical skills acquired.

One could argue that the emphasis on science and the abstract, on the professions and on narrowly defined technical skills and the needs of industry gives the CS course a distinctly 'masculine' feel (Kvande and Ramussen, 1989; Mahoney and van Toen, 1990; Verne, 1987; van Oost, 1992; Stepulevage and Plumeridge, 1998). In contrast, the ID course's emphasis on the social, the user and on generic technical skills and competencies gives this course a more 'feminine' feel. Indeed, in some ways, the ID course represents exactly the type of course many feminist commentators have been arguing for, but, the question remains, do women necessarily fare any better on such courses and are gender and technology relations any less unequal? I return to this question below, but first I

examine how gender and equality issues are understood on each of the courses.

On the CS course, equality and equal opportunities are understood in narrow terms as 'non-discrimination'. As the course tutor explained:

> Our philosophy is to teach the tried and tested methods without any bias to any particular group . . . the [programming] techniques they learn have got to be the ones that are going to be effective in employment. The overall philosophy is that which industry has found most effective.

Here, we can see how equality of opportunity is understood very simply as an opportunity to acquire the skills that industry needs. Technical skills are, as we saw earlier, considered neutral, it is access to them that remains the area of unequal opportunity. This access can best be extended by 'non-discriminatory practices', defined here as 'treating everyone the same'. Asked if equal opportunities policies impacted on the course itself, the course tutor responded: 'No, I can't say we have [made changes]. We are straight down the line, but meticulously so, in that we are the same for everyone.'

On the ID course, by contrast, equal opportunities is part of its raison d'etre. As described earlier, social as well as technical aspects of computing were consciously built into the course design to attract those usually marginalized from technological design and decision-making: users of computer systems, women and mature students and members of the local minority ethnic communities, in particular. Several strategies were adopted to ensure that equal opportunities became more than a token commitment. These were: targeted publicity specifically addressing underrepresented groups and placed in minority newspapers and magazines; an inclusion of gender issues in core modules; a specifically designed 'Women and Technology' option that provided hands-on technical skills (including database design and systems design modules) as well as an examination of the gendered relations of technology; an explicit encouragement for women to select from across the full range of options and not restrict themselves to traditional areas of female employment; and the inclusion of a critical approach to designer–user relations and the re-evaluation of users' knowledge and skills which provided a critical 'pivot' around which gender relations could be explored.

Thus, the CS course can be understood as adopting a typically liberal approach to equal opportunities, offering no more than 'the same for all', whereas the ID course appears to offer both a much broader interpretation of the problem and a set of practices potentially able to 'open up' and dismantle the liberal discourse, subjecting both gender and technology to much closer scrutiny within a theoretical framework closer to constructivism. One would expect, therefore, that women would fare much better on the ID course than on the CS course and it is to this question that I now turn.

In order to compare how the two groups of women fared in terms of formal outcomes, I examined pass rates and grades for each group. However, I followed this with an analysis of data collected via observation and interview to comment on perceived levels of technical competence in the two groups. The most interesting finding here is the lack of congruence between the two sets of data, pointing to issues of confidence and 'ownership' of technical skills that I relate to gender–technology relations more generally.

Gender, Competence and Confidence

Two indicators were used to measure competence: the average marks achieved for the module (expressed in percentage terms) and the percentage of students passing the module. The results for each of the two groups (CS and ID students) were then compared. On the basis of these figures alone, women appear to fare better than men on both courses. In the CS group, the pass rate for men was 55 percent and for women it was 60 percent. In the ID group, 100 percent of women passed the unit, compared with just 50 percent of men. Average marks were similar for CS men and women (42 and 43 percent respectively), but significantly different for ID men and women, at 47 and 58 percent respectively.

What general points can be drawn from these data and what do they tell us about gender and technology relations more generally? The answer is, of course, very little. The sample is very small and we have followed only one year group/cohort. However, what can be said is that when formal outcomes, alone, are examined, women are not necessarily or, in all cases, disadvantaged on computing courses, either conventional or interdisciplinary ones. Furthermore, the data suggest that interdisciplinary courses may have something special to offer women, enabling a 100 percent pass rate for women in this group in our study. Further analysis of the data (combined with analysis of data from other studies of this kind) would be needed before any attempt could be made to generalize these points or to identify the precise contexts within which women achieve best results. Here, my aim is to examine why, given the satisfactory and, in some cases, often excellent formal outcomes for women on these courses (i.e. their 'success' in liberal terms), these women continue to underestimate their competence in technical skills.

I attempted to measure perceived levels of technical competence precisely because, following a broadly constructivist framework, I recognized that skills are gendered and because I wanted to understand more about this gendering process. Would women continue to be defined, and to define themselves, as less technically competent than men despite evidence to the contrary on these courses? How would the gendering process differ between the two course cultures and why? The data on

perceived levels of competence analysed here come from three main sources:

1. Students' perceptions of their own level of competence as reflected in their answers to the following question from an interview held towards the end of their studies: 'If you had to categorize yourself in relation to technical competence now, how would you describe yourself (expert/technically skilled/beginner/other)?'
2. Students' perceptions of other students' technical competence from answers to the interview question: 'Is there a particular student or students that you consider especially competent?'
3. The observer's perceptions of competence in workshops, assessed via demonstrated ability to get on alone and/or help others.

What is clear from these findings is that the women tended to underestimate their competence. In the ID group, despite accounting for four of the top five grades, women were not confident of their skills. Two of the women defined themselves as 'very poor' and 'can manage' but gained overall module grades of 60 and 55 percent and were considered competent by the observer. Another woman defined herself as 'a beginner' but the observer considered her to be one of the 'experts' in the group, working well in workshops and helping others to understand. Yet another defined herself as 'knowledgeable', but the observer considered her another expert and her final grade was the highest of the group at 70 percent. These latter two students were also named as 'experts' by others in the group. Only one of the women students' self-perceptions matched those of both the observer and the final grade.

The ID men, in contrast, were more mixed, with four having a perception that matched other measures of competence, just one underestimating his competence and others clearly overestimating theirs. For example, two defined themselves as 'intermediate' and 'competent and confident', but the observer saw them both as beginners and their grades were a fail and 47 percent respectively.

On the CS course, a slightly different pattern emerged. Nine of the 16 students in the group agreed to be interviewed, with probably some element of self-selection going on here. Only nine students in all passed the module and seven of these opted to be interviewed. It may be significant for the analysis of gender–technology relations here that two of the men who failed the module agreed to be interviewed, whereas the two women who failed declined to be interviewed. So, what we ended up with among our interviewees were two women who were doing very well on the module and seven men, two of whom were not progressing well. How did these students perceive themselves regarding levels of technical competence and how did such perceptions compare with the other measures of competence, discussed earlier?

As with the ID group, women in the CS group were less confident about their technical skills than they had reason to be. Both women viewed themselves as 'beginners', despite the fact that one achieved the joint second highest grade in the group and was considered by the observer to be one of the 'experts' in her group. The other woman also achieved an above average grade. The men, on the other hand, showed more confidence in themselves as technically skilled. Four of the seven described themselves as 'expert' or 'at least average' and three of these did, in fact, achieve grades among the highest in the group but, unlike the women, none of the men, including the two who failed the module, showed any signs of lacking confidence in themselves and their technical competence. Thus, despite achieving very similar grades to the competent men, the competent women in this group continued to feel underconfident about their technical skills. A further interesting gender difference in this group was the fact that the observed male 'expert' of the group was recognized as such by five students whereas the observed female expert went unrecognized by the students. In summary, then, women students tended to underestimate their own technical skills, both relative to other measures of their technical competence and relative to equally competent men. This was true both for the CS and the ID groups. Second, and especially the case for the CS course, women's expertise was less likely to be recognized by other students than men's.

Part of the explanation for the continuing underrecognition of women's skills on these courses can be found by examining everyday discourse and practice among staff and students, where the binary opposition of masculine–technical, feminine–non-technical continues to be restated despite evidence to the contrary all around them. In interviews, students were asked to reflect and comment upon women's underrepresentation in computing. Many responded using language and concepts that reflected and, at the same time, reinforced this dominant discourse. One CS student (male) commented:

> I suppose if you saw a woman who was a computer expert, you'd be less likely to take what she says as being correct, because I think computing is still male dominated so you'd look for a man to be an expert in the particular field, rather than a woman.

This comment could well be interpreted as a case of 'WYSIWYG' – 'what you see is what you get'. Because this man thinks of computing as a male field, he looks for a man to be the expert and he will, of course, find one. I would argue that, precisely because of his preconceived notions about gender and technical expertise, he is simply unable to see/acknowledge the expertise of the woman. Similarly, another male CS student commented:

> Women don't like programming, and find it boring. I don't know why. . . . I can't visualize a woman in front of a computer writing code. The women on the degree like IS [Information Systems], not programming . . . they are more interested in systems.

Here again, this man's preconceived notions about gender and technology – that women don't like programming – lead him to make a statement about women on the degree which cannot, in fact, be supported empirically. Women did not show any more tendency to choose IS as opposed to programming. However, so strong is the association he makes between men and programming that he simply cannot 'visualize a woman in front of a computer writing code', just as the last student could not visualize a woman computer expert.

Other male students suggested that girls are less interested and less bothered if they cannot 'get their hands on' the computers. Here are three typical examples of such views:

> I guess boys more always ask for the computer, ask for games and everything and the boy always gets the computer and the girls never get to the computer . . . she doesn't really care whether she gets to it or not.

> I think women don't like using their brains technically and mathematically and they like theory subjects, that's the main reason.

> It's typical, girls everywhere like something to read, read, read. They like learning by reading.

To a large extent, the women CS students can be understood as going along with these gendered constructions or, at least, of not challenging them overtly. First, it should be noted that it proved extremely difficult to interview the women: the two 'failing' students and one other refused to be interviewed at all. The other two were reluctant to identify themselves as women and preferred to interpret their experiences and strategies in terms of individual preferences and characteristics. For example, one of the women claimed that in her access course, prior to her degree course, she was the only woman in the class but she simply had not realized this until the teacher pointed it out to her. It appears that she was unconcerned (or even unaware) of gender here. However, when asked if it would have made any difference to her to have had more women on the CS course, she stated:

> Women's attitudes are different towards things . . . a lot of guys talk about computers but don't actually know much, as I found out. I think women are more hard working, including myself.

She related this hard work to the need to 'prove yourself more', a recognition of, and an attempt at, challenging the construction of women as

'technically incompetent'. Thus, it is certainly not the case that these women do not recognize some of the gendered constructions around them but that, when they do recognize them, they try to overcome them in very individualistic ways by distancing themselves from 'other women' or 'women in general', presenting themselves as 'exceptions', a construction that leaves the gendered dualisms untouched.

On the ID course, there appeared to be more space and opportunity for women to demonstrate technical competence and expertise and thereby begin to deconstruct the gendered discourses of technology. For example, the emphasis on collaboration and group work in workshops on this course helped facilitate a display of competence and confidence by one student who adopted the role of 'substitute teacher' in her group, a role that Walkerdine (1989) has argued can be a powerful one for women in a context in which they are generally positioned as less able than men. Another significant innovation on this course was the emphasis given to the computer user, which created a space in which the women students, many of whom had work experience as 'users' in offices, could begin to examine and appreciate their own skills and competencies. In addition, the fact that gender issues were raised in core modules and were not restricted to 'women's' modules, encouraged the process of reflection upon dominant discourses by all students. However, resistances were in evidence, too, in that these spaces had to be fought for and fiercely defended in some cases, especially where men were not doing very well and felt particularly threatened by women's growing confidence. One male student, struggling in his own acquisition of technical skills, expressed his resentment and anger towards women by reasserting the need for gender difference in a particularly aggressive manner:

> It would be unfeminine because when you look at women driving HGVs, [you might say] 'what is the difference, if a man can do it, why can't a woman?' Because [of] the hugeness of that vehicle, driven by a woman, and that woman is meant to be, you know, what should I say? I wish I had a way to class it. A woman is meant to be soft with lipstick, and you know, quite nice, easy going, but rather you see her sitting there driving a bus, to me, not other people's views, I think it's too much. I call that masculine.

There was also a heated debate about the provision of women-only space in the course's 'Women and Technology' option. Several male students were perceived by the women taking the option to be trying to undermine their choice by suggesting it was the option for 'lesbians'. These 'accusations' are interesting to consider because they draw to our attention the limits of tolerance among men for women acquiring technical skills and encroaching, as they see it, on 'their' territories. In the mixed environment of the introductory IT module, men and women worked together and men were happy to allow women to help and guide them, especially where the

women were in the fairly typical 'teacher' role, but the existence of women-only space where women are gaining technical skills and competencies for themselves alone is perceived as much more threatening to masculinity. Maintenance of the existing gender order, it seems, requires that gender difference be always visible. Where women work separately from men, such differences cannot be readily asserted and regulated. The labelling of the 'Women and Technology' students as lesbians suggests that the maintenance of the binary oppositions in dominant gender–technology discourse is fundamentally related to the maintenance of dominant relations of heterosexuality as well as gender (Henwood, 1998; Stepulevage, 1997).

TOWARDS A DECONSTRUCTIONIST APPROACH IN IT HIGHER EDUCATION

Although the numbers involved in this study are very small, the detailed qualitative data analysis undertaken does appear to suggest that there is some mechanism at work which continues to reassert dualistic gender categories and identities in gender–technology relations, despite what would otherwise be very convincing evidence of the potential for their demise.

The relationship between gender and technical expertise has been explored in various ways in the gender and technology literature, most often with women being understood as actively excluded from technology and technical expertise but the analysis given here suggests a slightly different understanding is needed. Women in this research were not being denied access to technical skills in any formal sense. On the CS course, although the proportion of women is low, women's formal outcomes (marks and pass rates) are no worse than men's, and on the ID course, they fare better than men on these measures. However, what this analysis does suggest is that, despite having reason to be as confident about technical skills and competence as the equivalent group of men, the majority of women in our research groups continue to underestimate their skills and continue to equate technical competence and skill with masculinity and men.

In dominant cultural representations, men and women are constructed in oppositional terms: men as 'good' with technology, women as technically 'incompetent'. These representations, rather than being accepted as reflective of some 'reality' or 'truth' about men's and women's attributes, need to be understood as part of the broader picture of gendered discourse that surrounds technology relations and that positions men and women so differently. What this research demonstrates is that to fail to understand the social and cultural nature of the gender–technology relationship will result in aborted attempts at change in those relationships. In contexts, like the CS course, that operate with a very liberal understanding of equal

opportunities, both 'gender' and 'technology' are taken at 'face value' and their cultural nature is not understood. This limits the space that exists within such courses for students (or staff) to examine the gendered relations of technology and the resistances to change in those relations. The broader understanding of gender–technology relations on the ID course opens up some spaces in which the cultural nature of those relations can be explored, deconstructed and challenged. However, this 'alternate' discourse does not exist in isolation and students (and staff) have to negotiate their way through the conflict posed by the intersection of this discourse with more traditional discourses that reassert binary oppositions.

In the analysis in this article, I have sought to understand how technology, gender and equality are understood and employed in discourses and practices on two computing courses and, in particular, how they work to produce more, or less, symmetrical gender relations of technology. I have analysed how 'everyday discourse structures individuals into a dualistic maleness or femaleness' (Davies, 1989: 238). However, I hope, at the same time, to have recognized that 'individuals are not passive recipients of social structure' (Davies, 1989: 238). Instead, I have argued that individuals can be understood as negotiating their way through sometimes contradictory discourses and positioning themselves differently within each different form of discourse, depending on the power and resources they have at hand. In particular, I have explored the ways in which these negotiations take place within each of the courses examined, noting how each context provides different resources and opportunities for women's empowerment. It is my view that such opportunities need to be extended through more innovative educational curricula.

In the final analysis, there is no one course philosophy that can offer 'equality' to women in computing just as there is no one neutral educational philosophy, subverted by the 'hidden curriculum' (as is so often suggested in liberal discourses of equality). What this research shows is that different computing course philosophies give rise to different curricula and spaces within which women are exposed to different understandings of technology, gender and the relation between the two. Whereas in the CS course, liberal discourses dominate leaving few opportunities for women to participate except on male terms, (with either/or, binary oppositions dominant), the ID course deliberately set out to challenge liberal discourses and thereby offer women greater opportunities for involvement and achievement. In this aim, it has been partially successful. However, it is my view that there is still room for a much fuller deconstructionist approach to be adopted in progressive IT education.

To encourage greater participation of women in computing alongside a fuller critique of technology relations, courses which actively encourage a challenge to dominant constructions of gender–technology relations are needed. Such curricula need to start by understanding what the dominant

constructions are and how they work. They also need to understand that language and discourse are not means to represent a separate reality but are constitutive of that very reality. As Davies (1989) has argued, we need to first understand the constitutive force of language and then develop different forms of discourse:

> If we can see the way in which the discursive practices within a particular text or used by a speaker (including oneself) locate or position us, the possibility of refusing that positioning, or even the particular discursive practice itself, and taking up another becomes more readily available. (Davies, 1989: 239)

Davies has argued that real change in education would involve empowering students to refuse sexist and oppressive discourses. Students need to be given the skills to learn to recognize the constitutive force of spoken and written language, to recognize and articulate the multiple and contradictory ways in which they position themselves and are positioned in the various discourses that they encounter, to analyse the personal and social implications of these various positionings, to recognize the constitutive force of the images and metaphors through which sex/gender is taken up as their own, to make choices about refusing the discursive practices and structures that disempower them or that constitute them in ways that they do not want and, finally, to develop and take up alternate discourses and gain the right to refuse old ones (Davies, 1989: 240).

Thus, it is not enough to reject the meanings and subject positions inherent in the dominant discourse surrounding gender and technology relations. As we saw with the women on the CS course, such rejection simply leads to what Fox-Keller has called 'negation in the quest for assimilation' (Fox-Keller, 1986: 169). Instead, we need to understand more about how those meanings are produced and how they work to offer up particular subject positions for both women and men to occupy. We also need to develop and promote alternative meanings and subject positions which reflect and assist the development of a wider range of femininities and masculinities, more inclusive of all marginalized groups. Education provides the ideal site for such interventions and, as this research suggests, interdisciplinary IT courses provide an excellent starting point for the development of serious deconstructionist work in IT higher education. However, it is important that such work does not assume universality in women's (or men's) experiences. Just as women's 'non-technical' identity is a symbolic construction that may not speak to the experience of all women, so men's 'technical' identity is not something which all men will recognize in themselves. Constructivist critiques based around a more 'postmodern' form of feminism which would recognize, and enable the production of, a wider range of femininities (and masculinities) might be a more appropriate starting point and yet these have not yet made any serious impact in terms of interventionist strategies in IT education.

What was particularly interesting about the findings of our research was the contradiction between women's competence, as measured via assessments and the judgement of an outside observer, and their own subjective experience of technical competence, which, as I have suggested, was undermined by the existence of dominant discourses that continued to assert women's technical incompetence. Rather than leaving individual women to struggle with this tension alone, I suggest that education has a key role to play in the identification and deconstruction of such discourses. Furthermore, I would argue that it is precisely by exploring the tension between the structural, the individual and the symbolic aspects of gender that arise when women acquire technical skills that a productive starting point for such deconstructionist approaches in IT education can be found.

NOTES

1. The research on which this article is based was undertaken with two colleagues – Linda Stepulevage and Sarah Plumeridge – and several single and jointly authored papers have already been published (Stepulevage, 1997; Stepulevage and Plumeridge, 1996, 1998; Stepulevage et al., 1994); but the analysis provided here was undertaken by the author alone and builds on earlier work analysing discourses of gender and technology in educational settings (Henwood, 1996, 1998).
2. These proportions are not representative of the course cohorts overall, where women represented 20 percent of all the CS students and over 50 percent of the ID students. Thus, our research groups (at about 30 percent and 40 percent women, respectively), overrepresent women on the CS course and underrepresent them on the ID course.

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