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Women@Work: listening to gendered relations of power in teachers' talk about new technologies

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ABSTRACT   *This article examines teachers' working identities, focusing on gender inequities among teachers, within the school system, and in society, especially in relation to their competence with and use of computers. It highlights some of the less obvious tensions that are central to the work of teaching in relation to these new technologies, paying explicit attention to the gender inequities that continue to structure our understandings of both teaching as a profession and technology as a cultural artefact. In particular, the article documents how, for the teachers who were studied, perceptions of expertise and experiences of access in relation to new technologies were produced and maintained by the gender inequities evident in computing cultures pervasive in both schools and society more generally.*

This article will explore some of the pressing concerns of teachers faced with the recent and ongoing demands made by provincial policy-makers, administrators, and parents to implement and integrate computer technology in primary and secondary schools in Canada. In particular, we focus on the ways in which these concerns are complicated and shaped by gender inequities among teachers, within the school system, and in society more generally, especially in relation to their competence with and use of computers. Like many of the studies which have been conducted on computing in schools in the last 25 years (see, for example, Turkle 1988; Elkjaer, 1992; Culley, 1993; Schofield, 1995; Bryson & de Castell, 1996; Anjos, 1999; Jenson, 1999; Hill, 2002), we were struck by what has been characterised elsewhere as a masculinised culture of computing (Wajcman, 1991; Bryson & de Castell, 1998; Clegg, 2001). This masculinised culture, we will show, creates and sustains tensions inside and outside school walls, contributing in more and less inhibiting ways to teachers' (mis/dis)use of new technologies.

In this study, conducted over the last two years, we visited 30 schools and 18 school districts in five Canadian provinces where we interviewed teachers, technical support staff, and administrators in order to document the difficulties, questions and possibilities they encountered in making use of computer technologies in the classroom [1]. Rather

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than aiming to survey or quantify the issues at stake, these school visits were intended to produce a series of detailed case studies that would examine the implementation and integration of computer technologies in Canadian classrooms, with a focus on the human, rather than technical, dimensions of this new social environment. Of importance to us, then, was to better understand and then show how teachers and their administrators were attempting to come to terms with top–down, provincial and district mandates to make more and better use of computer technologies in teaching and learning. In this article, we draw on two of our case studies in order to highlight some of the less obvious tensions that are central to the work of teaching in relation to these new technologies, paying explicit attention to the gender inequities that continue to structure our understandings of both teaching as a profession and technology as a cultural artefact.

Methodologically, our decision to explore just two cases in depth rather than to generate and report on a large data set encompassing all the schools and all the classrooms we visited was driven by our awareness of recurrent and all too familiar discrepancies between the typical findings of large-scale studies of computer use in schools, and small-scale ethnographically grounded classroom studies of teachers and students at work. For example, large-scale surveys of teachers' computer use most typically disregard gender as a significant category for analysis (Kramarae, 2001). This is strikingly contradicted by our face-to-face observational studies of teaching and learning with new technologies, in which persistent patterns of gender inequity are all too tangibly in evidence. Failure to observe gender inequality in schools is as entrenched a part of educational research as it is an entrenched practice among classroom teachers, representing as it does a self-sustaining arena of 'cultural embarrassment' which 'not seeing' both keeps at bay, but also, of course, keeps firmly in place. It is, then, through the lens of the 'everyday,' micro-practices which we have chosen to focus on that gendered practices and viewpoints can be seen to be most stubbornly in place. The teachers' narratives we elucidate here are not atypical (see, for example, Bryson & de Castell, 1998; Anjos, 1999; Jenson, 1999; Hill, 2002), and importantly, we think, describe the daily cultural condition/s for female teachers in relation to new technologies.

Working with Computers in Schools

In the context of state-funded public education, teachers are irrevocably caught up in the tensions between government systems, community networks, and more and less flexible institutional structures, and acting within each of these, teachers must negotiate complex and even contradictory demands. Meanwhile, the ever-increasing diversity within Canadian schools has prompted teachers and principals to explore collaborative planning strategies and non-traditional methods of instruction even as teachers are faced with highly elaborate and often less flexible curriculum guidelines from ministries of education.

In addition, there is an overwhelming contemporary preoccupation with the importance of science and technology in public education (attended by what many see as a correlative marginalisation of the arts and humanities). Many teachers feel the pressure of functionalist discourses in the arenas of politics and education, which assert that students must be trained to compete for jobs in a future sure to be dominated by techno-science. These socio-political demands add to the already complex set of tensions that teachers face as they try to navigate many roles, including those of state employee,

educator, caregiver, community member, and, more recently, computer user. The challenges and demands faced by teachers become heightened as they try to grapple with the introduction of a new curricular domain as logistically vast and socially meaningful as the computer.

That computer technologies in schools seem for teachers simultaneously to pose overwhelming demands and exciting possibilities is partly the result of the kinds of discourses that have been employed by educators and administrators to both justify their presence and explain their educative relevance. In the introduction to this article, we used both 'implementation' and 'integration' to describe the relation of computer technologies to schools. While these terms are often used interchangeably, there are, we assert, important differences in meaning between them which, when more fully described, could illustrate the tensions at stake with the introduction of any new curricular piece—in this case, computer technology.

To use the term *implementation* places an emphasis on the use of a ready tool or piece of curriculum. It suggests that computer technologies may be applied by teachers themselves or by an outside force, such as administrators or school districts, and suggests that computers are tools in which educative ends are already embedded, needing only be 'implemented', that is, used (without critical attention or even skill) and 'put into practice' by practising teachers. In this case, computer technologies are positioned as an addition to the ongoing practices in schools. *Integration*, on the other hand, is a term that implies the blending of resources and tools and the incorporation of computer technologies into schools. In slight contrast to implementation, integration suggests that teachers and school communities themselves could choose to make use of computer technologies as central to the changing nature of their work. In this sense, computer technology is positioned as a new feature of life whose emergence might change school-based practice.

The differences between these terms point to a tension in our thinking about how best to facilitate the large-scale introduction and use of computer technologies in primary and secondary educational institutions. Should governments impose requirements that teachers use these technologies regardless of their own instructional practices? Or should teachers have the freedom to choose whether and how these technologies are valuable in their working lives? In practice, of course, the experience of teachers and schools exists somewhere between government prescription and local decision-making, and many would argue that both of these dynamics are central to the practice of public education. At the same time, teachers' experiences of getting access to and using computer technologies in their schools and classrooms raise concerns about structures of control over teachers' working conditions and their sense of power and expertise as professionals. How are existing power relations in schools reinforced and/or reorganised by the introduction of computer technologies? How do these new technologies change the work of teaching and how do these changes undermine or encourage the teacher's sense of herself as a professional? How does the introduction of computer technologies limit or promote the teacher's sense of control and ownership in the work of the institution? These questions emerge from a series of conversations and experiences we had with individual teachers whose schools participated in the development of our case studies. Like Janet Schofield's study of computers and classroom culture (Schofield, 1995), which 'did not set out to study gender', we found that the above questions about the changing nature of teachers' work and their sense of that work consistently raised issues of gender inequities both in the context of schooling and in relation to the technology itself.

Gender and the Culture of Computing

Studies of the culture of computing and other new technologies over the last 25 years or so have consistently reported the masculinisation of both tools and expertise (see, for example, Cockburn, 1985; Sanders, 1985, 1995; Wajcman, 1991; Schofield, 1995; Volman *et al.*, 1995; Whitehead, 1996; Volman & Ten Dam, 1998). Technology and gender, these studies argue, are delimited by the social and cultural context in which they are produced and utilised, and as such, the applications of technologies are mediated by social and cultural perceptions of their functions (Cockburn, 1985; Wajcman, 1991; Franklin, 1992; Noble, 1992, 1995; Balsamo, 1996). Wajcman (1991) writes, for example, that technology refers not only to 'hardware,' but also to the knowledge and practices that surround its use:

> [Technology] fundamentally embodies a culture or a set of social relations made up of certain beliefs, desires and practices. Treating technology as a culture has enabled us to see the way in which technology is expressive of masculinity and how, in turn, men characteristically view themselves in relation to those machines. (p. 149)

Contributing to a masculine culture of computing is the heavy marketing of computers and software as 'toys for boys' (Culley, 1993; de Castell & Bryson, 1998). The sex-typed nature of the computer industry and its marketing produces not only an image of males as 'computer geeks', but also of females as passive and incompetent computer users. Several studies of the pictures in popular computing magazines (Ware & Stuck, 1985; Demetrulias & Rosenthal, 1985; Weinstein, 1998) have concluded that women were significantly underrepresented in images in computing and, further, that those images that did portray women showed them in stereotypical roles such as clerical workers, sex objects, or as models to emphasise ease of use (i.e. 'this computer is so easy to use, even a woman can use it'). Though this sexist depiction of women in computer (or any other) advertising is neither new nor surprising, it becomes crucial when considering male and female teachers' perceptions of computers, and thereby for beginning to understand the differences in their willingness to take up their socially defined roles in relation to computers.

Concomitant with studies that examine technological and computing culture have been those studies which document the underrepresentation of girls and women in technological courses and fields (Collis *et al.*, 1989; Siann, *et al.*, 1990; Sutton, 1991; Taylor & Mounfield, 1994; Lightbody & Durndell, 1996; American Association of University Women [AAUW], 1998, 1999; Dugdale *et al.*, 1998). While these studies tend to focus on students in school (elementary, secondary and post-secondary), studies about teachers' relationships to technologies suggest that teachers are subject to the same social and cultural constraints and responsibilities as their students (see, for example, Evans-Andris, 1995; Gordon, 1995; Rosen & Weil, 1995; Brosnan, 1997; Farby & Higgs, 1997; Bryson & de Castell, 1998). Teachers, like their students, then, grapple with social and cultural constructions of gender in relation to technology, which always already position women as less confident and competent than their male peers.

In the two case studies that follow, we document how, for the teachers we studied, perceptions of expertise and experiences of access in relation to new technologies were produced and structured by the gender inequities evident in computing cultures and pervasive in both society and schools. These case studies highlight what we felt was the most important, and very rarely documented, barrier to teachers' access to and use of computers—a pervasive institutional blindness to the masculinised culture of computing

within the school generally. In each of the schools and districts we visited across the country, both elementary and secondary, very few (if any) women held technical computing positions or even technological support positions (though there were more women in these roles than in purely technical roles). Most of the computer labs in elementary and secondary schools were taught in and 'overseen' by male teachers, and even when a male teacher did not teach primarily in the computer lab, he was perceived by other teachers in the school to be the primary user of the lab, as well as the primary technical person to consult if there were questions or if there was something that teachers wanted to do in the lab. In this study we argue that not only is the gendered culture of computing within schools one important consideration among many for facilitating teachers' implementation/integration efforts, it is central to understanding in what ways this technology integration might even be accomplished.

Case Study One: professional identity and expertise

Our first case study, involving a teacher librarian named Donna [2], provides a rich example of the ways in which perceptions of technological expertise are gendered by the culture of computing within the school because she is someone who has a great deal of both technical skill and organisational power. For five years, Donna has been the teacher librarian [3] at Lexington Public, a small inner-city public school in Ontario, and she works closely with the grade teams in her school as a resource person in the development of curriculum and the integration of computer technology in the classroom. In addition, during the course of our study, Donna held, for a short time, the position of Acting Principal, which indicates that her work and expertise are highly respected by her superiors. Of all of the schools we visited across Canada, Lexington is one of the most advanced in terms of the number of teachers using computer technologies and their non-traditional and project-based approach to integration.

Donna's computing skills have been developed through a combination of school sponsored workshops and self-funded professional development at outside institutions. She is a member of Lexington's three-person technology team, which also includes two male teachers, both of whom teach skills-based classes in computer technology to all grade levels in the school's computer lab. Donna's position on the technology team is a combined result of her expertise with computer technology and her role as teacher librarian, in which she oversees a wide range of educational resources. Interestingly, this perception of school librarian as a role that should be closely linked to the school's integration of computer technologies was not evident in many other schools. In most schools, the librarian and the library itself were often described by teachers working with technology as antiquated and perceived as competition for the allocation of funding for technology.

Despite Donna's technical skills and knowledge of computer technologies, her position on Lexington's technology team and in the school at large reflects an overall climate wherein female teachers are relegated to the position of 'general support' while male teachers are positioned as 'technology experts'. Donna functions primarily as the liaison between the technology team and grade-level teams, and helps the grade-level teams access the technological resources they need to meet their curricular demands. Her male colleagues and fellow members on the technology team handle all instruction in Lexington's advanced technology center, which each class visits once a week to acquire training in computer-based skills and assistance with class projects.

Donna's school has taken the approach of creating a technology team that works with

school staff to integrate computer technology throughout the school. This approach contrasts sharply with the more common strategy of designating one information technology (IT) support person whose job is to maintain the school's equipment and answer teacher queries. In almost all of the schools we visited, this designated IT support position had been filled by a male teacher whose time was almost entirely allocated to the technical work of keeping the school's computer technology operating. While Donna's school distinguished itself in its development of a collaborative technology team, many of the same dynamics around perceived expertise persisted. When teachers at Donna's school require technical assistance, they call upon her male colleagues, who are seen by their peers to be the school's technology experts. Donna's role on the technology team is described by her male peers and the principal of the school as that of a facilitator or liaison between the inaccessible world of technical expertise and the practical world of the classroom. While Donna considers herself to be someone who has technological knowledge and technical expertise, in our conversations with other teachers in the school, she was not named as a technology 'expert.'

It is these inconsistencies, between actual and perceived expertise, which illuminate the gendered power relations pervading school-based perceptions of teachers' professional roles in relation to computer technologies. In a Canadian study completed nearly 10 years prior to this one, Bryson & de Castell documented a pattern of hiring or promoting male teachers into positions of responsibility for computer technologies in schools, even when male and female teachers were equally skilled (Bryson & de Castell, 1998). In our own work we also noted that IT support positions were most typically held by men. In some of the elementary schools we visited, for example, there was a tendency to hire male teachers with experience in the computer industry or computer science, despite there being little or no overlap between a computer scientist's knowledge base and the kinds of knowledge relevant to educational uses of technology in elementary schools. These hiring practices pay little attention to the kinds of technologies actually used in schools, and to the kinds of educational uses teachers and learners actually make of these technologies, and they overlook, as well, expertise women may bring to their work as teachers with previous experience in female-dominated professions, such as clerical or administrative work.

Unlike her two male colleagues on the technology team, Donna was not initially hired for her expertise with computer technology. Her expertise has developed through her work as librarian and in response to the increasing presence of computer technology at Lexington. As a result, Donna has had to forge a professional identity for herself in relation to computer technology and in relation to her male colleagues who were from the start hired and positioned as 'technology experts' for the school. That gender plays a powerful role in the formation of her professional identity and sense of expertise became evident in our first interview with the technology team at Lexington. The gender dynamics we observed in this first interview raised concerns for us about the ways in which female teachers like Donna are often positioned, despite their actual expertise, as an insufficient source of information and technical skill in relation to the school's integration of computer technology.

During our interview with the technology team, Donna listened patiently to her two male colleagues as they responded to the majority of our questions. When we specifically directed questions to Donna, she was consistently interrupted by her male colleagues when she tried to respond. In their own responses to our questions, Donna's colleagues said several times that they 'don't know what the technology team or grade-level teams would do without her' because she is solely responsible for 'keeping everything together'

and coordinating the communication that happens between teams. While this is a lovely compliment, it seems quite clear that Donna's colleagues are describing her position on the technology team as having very little to do with her expertise in relation to computer technology. Rather, Donna seems relegated to a sort of parental role (that of 'mother') where she is expected to keep 'the boys'—her male colleagues—in line and on task (on the impossibility of doing this, see, for example, Walkerdine, [1990]).

While initially we understood these gender dynamics as possibly quite specific to the (inter-)personal dynamics of this particular group of teachers, we discovered that these kinds of assumptions and perceptions followed Donna into other professional contexts and seemed to be of concern to other female teachers at other schools. One of our follow-up visits to Donna's school coincided with a school board sponsored professional development workshop on computer technology integration. The technology team and other staff at Lexington had been invited as one of the school board's flagship schools in technology integration to develop the workshop for other schools in their district. The members of Lexington's technology team as well as their principal and several other teachers made presentations to 60 participants from five district schools on the first day of the four-day workshop.

While the team of teachers from Lexington selected by the principal to attend the workshop represented a fairly equal gender ratio, all of the male team members were responsible for aspects of the workshop addressing the specific use of computer technology while only two female team members offered sessions—on pedagogy and inquiry. For example, male team members gave PowerPoint presentations on the use of the World Wide Web, the use of peripherals, and the design of computer-based databases. Donna and one other female teacher spoke briefly to the group about the importance of an inquiry-based pedagogy when integrating technology. Donna's presentation (which also used PowerPoint) focused exclusively on what this inquiry-based pedagogy looks like without making any explicit connections to the use of computer technology. Unlike her male colleagues, who each operated their own equipment to move between their presentation slides, when Donna went to do so, one of her male colleagues insisted on stepping in to operate the computer for her. The other female teachers from Lexington who were present did not participate as leaders in the workshop. In addition, as technical problems arose throughout the duration of the workshop, it was always the male team members who stepped forward to correct them, often taking over from female teachers rather than offering assistance.

These gendered divisions and dynamics have the effect of reinforcing the perception, both among the staff at Lexington and in front of the 60 workshop participants, that female teachers are not 'technology experts', or even competent users or troubleshooters, again regardless of their actual expertise. Donna was not asked by her principal to share her expertise with computer technology despite her years of experience working with this technology as a librarian and teacher. Like several of her female colleagues whose seniority and experience at Lexington surpassed that of their male colleagues, Donna's professional identity and expertise were marginalised and, thereby, her own integration efforts were too often set aside or stymied by her male colleagues' positions as 'experts'.

Working Conditions: access and availability

The technology available in the schools we visited across the country deviated widely, and not necessarily along predictable socio-economic lines. As in the case study above, some of the schools we visited in poorer districts (often labelled by districts as 'inner city'

schools) were the best equipped technologically and made the most school-wide use of machines while those in more economically affluent areas had far fewer machines in the school and made far less use of the ones that they had. One obvious reason for this kind of disparity could be that in the more affluent areas students already had and used computers (often far more up-to-date and powerful/faster than those schools could provide) in their homes (indeed, in an elementary school in Nova Scotia that we visited the vice-principal claimed that 80% of the students in his school had computers in their homes), and therefore did not require or demand access to digital tools or the acquisition of computer skills in their schools. While we did not document the ratio of students to computers in the schools we visited, we did ask specific questions about what kind of access was available to computers and other kinds of technologies in the school (i.e. computers located in a single lab, multiple labs, in the library, in classrooms) as well as questions about the organisational structure of access and support (i.e. school-wide mandated lab time, a resource teacher for IT support, equal numbers of computers in classrooms, and so on).

As could be expected, access structures and kinds varied in each context we visited, and figure importantly, we think, in institution-wide implementation/integration efforts. In this next case study, we have chosen to focus on one small part of this issue, that is, beyond the typical and already well-documented barriers to accessing computer-related technologies in the school (Becker *et al.*, 1999; Bryson & de Castell, 1998), we asked what the material working conditions for teachers are within schools and how these conditions make it more and less possible for them to make use of computers with their students. In asking this question, we hoped better to understand the relations between and among teachers, and the relations between teachers and the organisational structure of the institution as each is related to issues of access to technologies and informed by the gendered culture of computing.

Case Study Two: access and control

Phoenix Elementary school in British Columbia is a medium-sized (350 students) urban elementary school which has been classified by the school district as 'inner city', meaning both that it drew from a low socio-economic catchment area and that it had significant numbers of students with behavioral and learning issues. The school itself is technologically well equipped: it has two computer labs and one classroom in which students have computers at their desks for three-quarters of the day. Each of the teachers in the school rotates through the computer labs on bi-weekly basis with most of this time allocated for the use of a district-wide implemented instructional software program, which is meant to improve students' mathematics and literacy skills. At the time of our visits in spring and autumn of 2000, many of the teachers in the school had been working to upgrade their technological skills by taking (in their own time and using their own money) a two-year professional certificate in educational technology through a local university, motivated in part by the district mandate that their students make use of the instructional software, but also by their individual impetus to increase their own computer skills and improve their own pedagogy in relation to new technologies.

We interviewed two teachers at Phoenix who were just completing their two-year certificate, asking them to describe some of the barriers and difficulties they had encountered while implementing their technology-based projects with their classes. Both women spoke about the difficulties they had in getting help when something went wrong and in accessing the equipment that they needed, identifying two male teachers (one

technology-support teacher who was given release time to 'keep the computers working' and the other, a grade five teacher who was perceived to be an 'expert' in the school and who had applied for and received a grant from the province to have enough computers in his classroom for each student) in their school as the 'computer experts' and as the 'gatekeepers' for access to equipment. At Phoenix Elementary, these male teachers, in consultation with the principal (also male), made all of the hardware and software purchasing decisions for the school.

Beth, a practising teacher for 18 years and head of the English as a Second Language (ESL) programme in the school, shared the difficulties she had getting help with technical questions from either of her male colleagues. First and foremost, they were often 'too busy' to help her, and could not answer her question until days later—by which time she had either solved the problem or moved on. Furthermore, she felt that when they were able to assist her she did 'not know enough' to understand or make relevant the answers that they formulated for her and that too often they ended up 'just doing it for her' instead of 'showing' her how to solve the problem herself. As a result, she said that it frequently took her much longer to work through simple and mundane technological problems than it needed to, and this made it difficult for her to spend more time thinking about and experimenting with classroom projects.

Lynn (in her third year as a teacher) agreed that although her male colleagues were the two most knowledgeable teachers within the school who could provide technical help, when called on for help, these teachers were not 'helpful'. However, she also asserted that through the two-year professional development course on technology she had learned to 'ask the right questions' so she could get the help that she needed. When asked what were the 'right questions', Lynn indicated that as she became more familiar with 'technical lingo' through her university course, she was better able to ask for help from her computer using colleagues. Beth was much more specific, indicating that both male teachers tended to use 'technicist' language which she felt was unnecessary and deliberately alienating.

While Lynn was able to find a way to get the help that she needed to make effective use of computers in the school, Beth had to negotiate her own way, and therefore felt that she accomplished much less than she could have in terms of advancing her own technological skills and in terms of what sorts of projects she was able to do with her students. The masculinist discourse of computing has been well documented as isolating and exclusionary for girls and women (Collis, 1986; Elkjaer, 1992; Culley, 1993; Clegg, 2001; Stepulevage, 2001; Hill, 2002). Both Lynn and Beth suggested that their male colleagues' use of this language was not only unnecessary, but exclusionary—it allowed these male teachers to isolate themselves from the rest of the school and 'do what they want' with little interruption or interference, as most teachers in the school felt intimidated to go to them for help. Other female teachers at Phoenix often sought out Lynn and Beth instead of the male 'technology experts' because they were perceived as technically competent due to their enrolment in the university course, but not as 'experts' whose technical knowledge set them apart from the struggles of the majority of the teaching staff.

At further issue for Lynn and Beth were their efforts at making effective use of computer technologies with their classes and, thus, their physical access to the only LCD projector in the school, which hooked easily to a laptop or the teaching machine in the lab. This projector was most often in the classroom of another teacher, Henry, one of the two teachers considered to be the school's technology experts. Although the projector was purchased for all the teachers in the school to use and was on a travelling cart so

that it could be moved between rooms, Henry used it most frequently (Lynn and Beth said, in fact, that it was always in his room). Because of this, teachers who wanted to use the projector had to go to Henry's room and move it to the computer lab. The teachers we spoke to felt that the projector should be kept in the lab and felt that their use of the projector was limited partly because it was an inconvenience to go to Henry's room to pick it up, but mostly because they were 'uncomfortable' taking the machine out of his room and could never be sure when he was using it. Lynn was especially adamant that the projector needed to be available for more general use, describing how it would make instructional strategies possible for her that were not possible in the lab without it. She described, for example, how being able to use a projector to show her second grade class a new skill meant that she could model the skill with the students watching, then the class could all try it together (watching on the projected screen and then replicating the skill on their own screen). Using this strategy, Lynn described how nearly all the students in the class could perform the new skill with less confusion and with less one-on-one help.

Being denied access to the projector had definitive repercussions for both Lynn and Beth in terms of whether and how they attempted to make curricular and integrated use of computers with their classes, beyond typing practice and use of commercial instructional software. Lynn and Beth's description of their use of computers at Phoenix Elementary shows how frequently it was mediated and too often inhibited by their male colleague's expertise and control of computer-related equipment in the school. The difficulties that Lynn and Beth describe, in accessing and using technology in their school, are not simply determined by the ratio of students to computer or the amount of lab time allocated to each teacher's class. And while it might be easy to dismiss the impediments we describe as mere 'complaints' or 'excuses' and therefore not 'valid' reasons for not more thoroughly integrating technology into their curriculum, to dismiss them as such, we argue, misses the importance of these kinds of relations in schools to whether and how technology is used by teachers within a particular setting. In this school (and others), these female teachers found it not only difficult, but nearly impossible to negotiate the relations with their male peers in such a way that they were able to gain any real autonomy or control over their own use of computers.

Conclusion

Studies that examine the introduction of technologies in schools often overlook what these technologies mean for the working conditions and professional experiences of teachers. Instead, these new curricular objects are examined for the kinds of changes they instigate in the practice of instruction and the experience of learning. While these are crucial areas of concern, much of our research indicates that privileging the practice of instruction does not account for all of the ways in which teachers perceive their work in schools and neither does it account for the various kinds of learning that occur outside of the classroom and in the school community. Teachers' working conditions and experiences of identity certainly impact the kind of instruction that occurs in relation to new technologies. In addition, the kinds of gendered beliefs and perceptions that pervade the school-based use of computer technologies contribute to a learning environment that extends beyond the boundaries of the classroom. Students and teachers alike seem to be learning that technologies constitute a male domain.

Instead of focusing on finding a causal connection between teachers' technological skills/resources/understandings and their instructional integration of computer technol-

ogy, our work suggests that not only should the school's sociocultural and political context be taken into account, but that the context in which teaching occurs is central to whether and how teachers make use of computers in the school, and, in particular, their daily working conditions. The extent of teachers' use of new technologies in schools is not only socioculturally mediated, but at times has very little to do with how technologically skilled or unskilled teachers actually are. In the case studies we describe, for example, Donna, Lynn and Beth were all technologically skilled, but their 'skills' had very little impact on their actual use of computers with their students. For Donna, this use was both mediated by the male technology 'experts' who positioned her as the person who 'facilitated' relations between their 'world of technology' and the 'world of the teacher' *and* by Donna's own willingness to accept and maintain that position given that she saw it as essential to promoting technology-use in the school generally. Likewise, Lynn and Beth's use of computers had little to do with their actual skills or instructional practices, but was highly regulated by a culture within the school which afforded them little or no recognition as skilled users of technology and by the everyday, practical political hierarchies which delimited what technologies they could have easy access to (e.g. the projector).

It is precisely these complex and often unacknowledged social relations of power and control that delimit teachers' use of technologies in schools. Continuing to look for relatively simple connections between teachers' skills acquisition and their instructional use of computer technology obscures the importance of relations of power and inequity which shape the school environment and the nature of teachers' professional lives. Instead of a linear or causal analysis, our study suggests that research on the integration of technology in schools requires a more holistic and qualitative approach that takes into account the way in which teachers' work is mediated by a complex set of sociocultural beliefs and practices. In each of our case studies, the work of teachers is produced by and also reproduces a climate in which female teachers are not imagined to be technology users regardless of their actual expertise, and this has implications for their female students, in turn, and acts to perpetuate the well-documented underrepresentation of girls in technology-focused courses and programmes (Bryson & de Castell, 1998; Kramarae, 2001). In this sense, changing individual attitudes and beliefs is not a solution to the inequities of computer use among teachers. Neither the male teachers nor the female teachers we interviewed can be held personally responsible for the social relations that shape their practices. What is required instead is an understanding of the school community and environment as a complex and collectively wrought sociocultural space that is the medium through which the work and identities of teachers are both produced and producing. It is only by beginning to study and articulate the culture within which teachers enact particular roles and identities and negotiate various hierarchies and institutional structures that we may be able to renegotiate and reconstruct school relations that support and sustain effective and equitable technology integration.

NOTES

[1] The study described in this article was conducted as part of a larger study funded by the Canadian Social Sciences and Humanities Research Council (SSHRC) called 'Schools for the Knowledge-based Economy.' Principle researchers on this study included Dr Brian Lewis (Simon Fraser University), Dr Richard Smith (Simon Fraser University), and Dr Stan Shapson (York University).

[2] All names of teachers and schools involved in this study have been changed in order to protect their identities.

[3] In Canada, a teacher librarian's work includes both the teaching of regular classes and typical librarian duties. The position was created primarily in response to a funding crisis which made cuts to all but those services pronounced 'essential,' thereby prioritising classroom teachers' skills over those of a librarian.

REFERENCES

AMERICAN ASSOCIATION OF UNIVERSITY WOMEN (1998) *Separated by Sex: a critical look at single-sex education for girls*. Report commission by the AAUW (Washington, DC, Association of University Women Educational Foundation).

AMERICAN ASSOCIATION OF UNIVERSITY WOMEN (1999) *Gender Gaps: where schools still fail our children* (New York, Marlowe).

ANJOS, E. (1999) Students speak: accounts of gender, equity and technology from an action research project, unpublished master's thesis, Simon Fraser University, Burnaby, British Columbia, Canada.

BALSAMO, A. (1996) *Technologies of the Gendered Body* (Durham, NC, Duke University Press).

BECKER, H., RAVITZ, J.L., & YAN TIEN, W. (1999) *Teacher and Teacher-directed Student Use of Computers and Software* (University of California, Irvine and University of Minnesota, Center for Research on Information Technology and Organizations).

BROSNAN, M. (1997) The fourth 'r': are teachers hindering computer literacy in school children?, *Educational Review*, 21, pp. 29–37.

BRYSON, M. & DE CASTELL, S. (1996) Learning to make a difference: gender, new technologies and in/equity, *Mind, Culture, and Activity*, 3, pp. 119–135.

BRYSON, M. & DE CASTELL, S. (1998) Gender, new technologies, and the culture of primary schooling: imagining teachers as luddites in/deed, *Journal of Policy Studies*, 12, pp. 542–567.

COLLIS, B. (1986) Psychosocial implications of sex differences in attitudes toward computers: results of a survey, *International Journal of Women's Studies*, 8, pp. 207–213.

COLLIS, B., KASS, H. & KIEREN, T. (1989) National trends in computer use among Canadian secondary school students: implications for cross-cultural analyses, *Journal of Research on Computing in Education*, 22(1), pp. 77–89.

CULLEY, L. (1993) Gender equity and computing in secondary schools: issues and strategies for teachers, in: J. BEYNON & H. MACKAY (Eds) *Computers into Classrooms: more questions than answers* (London, Falmer Press).

DE CASTELL, S. & BRYSON, M. (1998) Retooling play: dystopia, dysphoria, and difference, in: J. CASSELL & H. JENKINS (Eds) *From Barbie to Mortal Kombat: girls and computer games* (Cambridge, MA, MIT Press).

DEMETRULIAS, D. & ROSENTHAL, N. (1985) Discrimination against females and minorities in microcomputer advertising, *Computers and the Social Sciences*, 1, pp. 91–95.

DUGDALE, S., DEKOVEN, E. & JU, M. (1998) Computer course enrollment, home computer access, and gender: relationships to high school students' success with computer spreadsheet use for problem solving in pre-algebra, *Journal of Educational Computing Research*, 18, pp. 49–62.

ELKJAER, B. (1992) Girls and information technology in Denmark: an account of a socially constructed problem, *Gender and Education*, 4, pp. 25–40.

EVANS-ANDRIS, M. (1995) An examination of computing styles among teachers in elementary schools, *Educational Technology Research and Development*, 43(2), pp. 15–31.

FARBY, D. & HIGGS, J. (1997) Barriers to the effective use of technology in education: current status, *Journal of Educational Computing Research*, 17, pp. 385–395.

FRANKLIN, U. (1992) *The Real World of Technology* (Montreal, CBC Enterprises).

FUNK, J.B. & BUCHMAN, D.D. (1996) Children's perceptions of gender differences in social approval for playing electronic games, *Sex Roles*, 35, pp. 219–229.

GORDON, H. (1995) An analysis of computer anxiety levels of secondary technical education teachers in West Virginia, *Journal of Studies in Technical Careers*, 15, pp. 21–29.

HILL, C. (2002) Contradiction, culture and computers, unpublished master's thesis, Simon Fraser University, Burnaby, British Columbia, Canada.

JENSON, J. (1999) Girls ex machina: a school-based study of gender, culture and technology, unpublished PhD thesis, Simon Fraser University, Burnaby, British Columbia, Canada.

KRAMARAE, C. (2001) *The Third Shift: women learning online* (Washington, DC, American Association for University Women Educational Foundation).

LIGHTBODY, P. & DURNDELL, A. (1996) The masculine image of careers in science and technology—fact or fantasy, *British Journal of Educational Psychology*, 66, pp. 231–246.

NOBLE, D. (1992) *A World without Women: the Christian clerical culture of Western science* (New York, Alfred A. Knopf).

NOBLE, D. (1995) *Progress without People: new technology, unemployment, and the message of resistance* (Toronto, Between the Lines).

ROSEN, L. & WEIL, M. (1995) Computer availability, computer experience and technophobia among public school teachers, *Computers in Human Behaviour*, 11, pp. 9–31.

SANDERS, J. (1985) Making the computer neuter, *The Computing Teacher*, 12(7), pp. 23–27.

SANDERS, J. (1995) Girls and technology: villain wanted, in: S. ROSSER (Ed.) *Teaching the Majority: breaking the gender barrier in science, mathematics and engineering* (New York, Teachers College Press).

SCHOFIELD, J. (1995) *Computers and Classroom Culture* (Cambridge, Cambridge University Press).

SIANN, G., MACLEOD, H., GLISSOV, P. & DURNDELL, A. (1990) The effect of computer use on gender differences in attitudes to computers, *Computers and Education*, 14, pp. 184–191.

STEPULEVAGE, L. (2001) Gender/technology relations: complicating the binary, *Gender and Education*, 13, pp. 325–338.

SUTTON, R.E. (1991) Equity and computers in the schools: a decade of research, *Review of Educational Research*, 61, pp. 475–503.

TAYLOR, H. & MOUNFIELD, L. (1994) Exploration of the relationship between prior computing experience and gender on success in college computer science, *Journal of Educational Computing*, 11(4), pp. 291–305.

TURKLE, S. (1988) Computational reticence: why women fear the intimate machine, in: C. KRAMARAE (Ed.) *Technology and Women's Voices* (New York, Routledge & Kegan Paul).

VOLMAN, M., VAN ECK, E. & TEN DAM, G. (1995) Girls in science and technology: the development of discourse, *Gender and Education*, 7(3), pp. 283–292.

VOLMAN, M. & TEN DAM, G. (1998) Equal but different: contradictions in the development of gender identity in the 1990's, *British Journal of Sociology of Education*, 19(4), pp. 539–543.

WAJCMAN, J. (1991) *Feminism Confronts Technology* (University Park, PA, Pennsylvania State University Press).

WALKERDINE, V. (1990) *Schoolgirl Fictions* (London, Verso).

WARE, M. & STUCK, M. (1985) Sex-role messages vis-à-vis microcomputer use: a look at the pictures, *Sex Roles*, 13, pp. 215–228.

WEINSTEIN, M. (1998) Computer advertising and the construction of gender, in: H. BROMLEY & M. APPLE (Eds) *Education/Technology/Power: educational computing as a social practice* (New York, State University Press).

WHITEHEAD, J.M. (1996) Sex stereotypes, gender identity and subject choice at A-level, *Educational Research*, 38(2), pp. 147–160.