THE PROMISE OF COMPUTER-BASED LEARNING:
DESIGNING FOR INCLUSIVITY
By Katy Campbell

Computer-based models of teaching and learning are receiving renewed attention in the post-secondary sector. As an example, in Alberta over $40,000,000 has been made available to the adult learning system under the Learning Enhancement Envelope (LEE) funding initiative, for alternative models of instruction and learner support. Technology will allow us to reach new learners, in new learning contexts, and potentially in new ways. Yet the new technologies in education may exacerbate the marginalization of some students if we do not attend to learning styles, learning designs, and access issues that are entangled with gender inequality. Technology, and technology-based models of teaching and learning, are not value-neutral; and neither are the vocabulary and prevailing metaphors, which can exclude women or include them in undesirable ways (Shade, 1993).

Gender-related inequities in access and support for learning have been evident since microcomputers were first introduced into classrooms in the early 1980s. Research examining the experience of females in technology-based classrooms reveals a consistent pattern, established in the early years in school, in which girls are discouraged from computing both as a process and as a career choice. Psychological and sociocultural factors include attitudes toward math and science, math anxiety, motivation to learn, access to resources, learning context, learning design, nature of content, and learning and cognitive style differences. Much of this research involves students who attended school in the 1970s and 1980s, and the undergraduate and adult learning population in post-secondary settings today. Thus there is a dearth of research on educational outcomes for the newest technologies as used by completely computer-literate post-secondary students.

Feminist theory about technology argues that the rational, objectivist design of computing environments reflects their military and masculine origins. From these origins come a reliance on an aggressive technical vocabulary, overuse of abstract problem-solving approaches, industrial and utilitarian design of computers and classrooms, and the action-oriented, competitive and arcade-style of much of the software available in classrooms.

How can women negotiate, and transform, a world of instructional technology that is, in effect, premised on their absence? *Can* new learning technologies and new learning designs support new teaching and learning opportunities? I think they can, and in ways that creatively promote inclusivity through representation and design, by:

1. allowing for alternative representations through dynamic processes and the linking of verbal, visual, and aural information to support diverse learning styles, preferences, and experiences

2. including large databases of resources previously unavailable to learners, inviting the inclusion of experiences of women and other marginalized groups for the first time, and supporting the inter-relatedness of perspectives

3. supporting relational ways of knowing and being in the world, ways that may be preferred by women

4. inviting the instructional designer to step outside linear, objectivist, traditional models of instruction[1] to create environments reflecting knowledge that is both intuitive and rational

LEARNING STYLES

The design of learning technologies and environments have reflected a view of cognitive development in which the "received knowing" of the rational Western intellectual endeavor is contrasted with the relational position of "connected knowing" described by Belenky, Clinchy, Goldberger and Tarule (1986, 1996). Until the mid-1990s computer-based learning had to be delivered on stand-alone microcomputers, so learning programs were self-contained on diskettes or interactive formats such as CD-ROMs. Learning designs were limited in two ways. They reinforced gender ideologies in content and images (Winkelman 1997), and they were constrained by technological environments that encouraged autonomous learning, since cooperative learning was difficult to implement in fixed computer labs in which data could not easily be shared. When designs use abstract, formal operations they privilege the rational learner and disadvantage those whose cognitive styles tend to be more concrete and associative (Turkle 1995). The increase in networked learning, which supports more interconnected learning activities, has ironically also perpetuated very flat, text-based designs, as multimedia elements have not been easily delivered via the Internet. Broad-band technology shows great promise in this regard, but it has not been widely available, or evaluated, for instructional purposes.

In the past decade learning theorists have suggested different learning styles that are somewhat gender-related: the *autonomous*, separate, or independent style, which typifies the majority of men (and some women); and the *relational*, connected, or interdependent style, which typifies the majority of women (and some men). Both Magolda (1992) and MacKeracher (1996) describe learning style preferences on a *continuum* of intellectual development, work that has important implications for the design of inclusive learning environments.

Magolda (1992), for example, examined 100 college students, trying to identify patterns of knowing and intellectual development over time in a post-secondary context. She started with the premise that students interpret, or make meaning of, their educational experiences as a result of their assumptions about the nature, limits and certainty of

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[1] For an overview of these models see Gustafson, K.L., & R.M. Branch 1997. *Survey of instructional development models* (3rd edition). Syracuse, NY: ERIC Clearinghouse on Information and Technology.

formal knowledge. She then described a developmental scheme in which ways of knowing are evolving, continuous and fluid, context-bound, socially constructed, and gender-related.

From the students' accounts Magolda identified four ways of knowing and intellectual reasoning from absolute knowing ("Truth is absolute") through transitional, independent, and finally contextual knowing ("multiple, valid perspectives exist"). Each category contains two distinct and gender-related patterns. Through the continuum, males tended to prefer challenge and debate, individual activities, and the use of external evidence, while females tended towards interindividual, collaborative activities, and demonstrated interchange and attenuation as discourse styles. Magolda's findings thus suggest that the strategies traditionally reflected in much of the highly structured computer-based designs available (Ewing, Dowling, and Coutts, 1998) are counter-intuitive for women learners. These environments have been based traditional perspectives on structuring learning; that is, they have been designed to reflect mostly knowledge-based (low-level), criterion-referenced, identifiable outcomes, on which controlled activities are based and assessed. The control of information presentation rests with the computer, rather than the learner, and the instructional strategies tend to be didactic and expository rather than supportive of knowledge construction. While appropriate for some learning tasks, these environments do not encourage the cognitive flexibility described by Spiro et.. al. (1988), and Jonassen et.al. (1997), and reflected in women's connected learning styles.

IMPLICIT AND EXPLICIT CONTEXT

The issues

If *how* one learns – learning style – is influenced by gender, then *what* one learns is equally so. The military language of computing (e.g. killing a job, fatal errors, crashing), as well as programs containing cultural and emotional associations hostile to women (Provenzo 1992) do little to promote an interest in computing among women. Themes, metaphors, and settings from sports, action/adventure, and battle exemplify competition and violence. The assumption that a user interface must be arcade-like to be engaging ignores the fact that such structures and images are familiar and intuitive only to those who have played or have been exposed to video games. Since boys outnumber girls in video arcades and in other informal computing environments (Culley, 1993), these interfaces are familiar primarily to the boys who come to computing as a recreation.

As an example, I recently received from a major publisher an evaluation copy of a CD-ROM based supplement for a first-year psychology course (*CyberPsych™*). The interface is based on a medieval castle that spins rapidly in the air. In order to open the program one must have some dexterity with a mouse and be able to click on a particular part of the castle while it is spinning. When asked to rationalize the interface, the publisher's representative confessed that the program was designed to resemble *Myst*™ , a very popular action/adventure video game, that only 13% of the female student population had ever played![2] Similarly, a Web-course design tool (*WebCT™*) uses language such as "hold your horses" and images such as a red metal toolbox, from which a hammer partially emerges, to represent a set of learning activities that includes annotated note-taking. Because the images evoked by these representations of the activities draw from traditionally male occupations (cowboys and carpenters), they are tacitly gender biased even though they do not contain explicitly negative or stereotypical images of women (Burge, 1990, 1994; Elkjaer 1992).

Scientific and mathematical examples also dominate in software; and accompanying simulations tend to be abstract, whereas females prefer real-life contexts with a social focus (Belenky et. al. 1986; Damarin 1991; Inkpen 1994). In these environments, software design is often text-based, expository, and sequenced, and learning tasks are set up to support individual, procedural problem solving and/or competitive and abstract activities, rather than being cooperative, collaborative, and narrative-based. In Inkpen's (1994) study, for example, women/girls preferred to work on tasks creating characters or finishing a story rather than creating new task levels

To the degree that the software draws primarily from traditionally male activities for images and content, then organizes the information in ways consistent with most men's but not most women's learning styles, women confront challenges to using the software successfully that men do not. However the division between women and men in cognitive styles is not a mutually exclusive one. Belenky and her colleagues, for example, point out that the women they interviewed did not reject abstraction as such but did attend to the context of the abstraction. They resisted the learning activity, in the sense that they refused to become engaged, when abstractions preceded authentic experiences or pushed them out entirely (1986).

Inclusive design solutions

With improved bandwidth over the Internet and multimedia technologies such as streaming audio and video, multiple representations of information are possible. Since not all learners fit neatly into our research categories,[i] multimodal designs that include graphical and dynamic representations (such as motion video, audio, and animation) will support more diverse cognitive and learning styles. We are beginning to see educational Web sites that offer not only information in a diversity of forms, but also represent that content from multiple perspectives. Examples of such hypermedia, problem-based sites, include *The Shell Island Dilemma* (http://www.ncsu.edu/coast/shell/index.html) and *Planet Earth Conflict: Yellowstone Wolf* (http://powayusd.sdcoe.k12.ca.us/mtr/ConflictYellowstoneWolf.htm).

Although hypertext and online social environments may support the connected ways in which many women prefer to learn, some may find these associative environments unfamiliar and difficult to navigate (c.f. The Cognitive Technology Group at Vanderbilt 1993; Tergan 1997; Oliver 1999). These learners tend to feel lost in

[2] This figure is based on Culley's estimates of an 8:1 ratio of boys to girls regularly involved in video games. This estimate could be somewhat different if adolescent girls in 1999 were surveyed!

hypertext/hypermedia designs as they link nodes that lead them to even more choices, especially if their exploration is not evaluated. The CTGV and others (c.f., Clariana 1993) suggest a design and cognitive strategy known "as learner control with advisement"[ii] which appears to be a gender-based preference.

To summarize, inclusive learning design guidelines include:

- no arcade-style designs, thus no competition, hierarchical information, violence; portray women as problem-solvers rather than victims or prizes
- stress characterization and relationships. (see Inkpen's study, described above).
- avoid competitive and aggressive metaphors from games, sports, adventures, and wars
- evaluate visual imagery and design for bias
- emphasize harmony with nature, concern for others; empathy and compassion. Women show a preference for working with scientific concepts with social value, concern with consequences of action on others, and an ethic of care
- represent objects or issues studied holistically
- gender-neutral, open-ended creative tasks such as collaborative writing

LEARNING ENVIRONMENTS

The issues

Even when the learning context and content are theoretically designed for inclusivity, the users do not necessarily come to computing activities untouched by social practices associated with gender. Communications technologies such as computer-mediated conferencing (CMC), virtual worlds, and microworlds can challenge ideas about computing as an individual (male) activity and hold promise for redefining computing as an opportunity for learning through interactions that promote inclusivity. In particular, teaching about, and for, social and political activism and agency may be enhanced by online worlds that focus on gender and identity issues. Especially interesting questions about the use of these worlds include those related to how people learn and practice a "disembodied" gender identity online.[3]

It has been assumed that some gender inequalities would be lessened in computer-mediated communications, since in face-to-face interactions inequalities emerge through non-verbal cues. A lack of social cues, plus the advantage of asynchronicity, may make the online conversation more equitable and safer for women. But despite the potential in CMC, there is some evidence that women have been silenced and even pursued and frightened in the online environment (Taylor, Kramarae, and Ebben 1993), thus transferring physical vulnerability into cyberspace.

There is also evidence of gender differences in how people talk, and so online interactions can be shaped by gender-based practices. Deborah Tannen (1990, 1994) argues that men and women have different speech patterns, men preferring expository

[3] see, for example, Sherry Turkle's [1995] accounts of fluid identities in "the age of simulations"

"report talk", while women like exploratory "rapport talk." Kirkup (1995) contends that the style of talk in CMC is very dialogue-oriented, privileging the expository style. This style is observed in males online, whose behavior is consistent with adversarial relationships: put-downs, strong, often contentious assertions, lengthy and/or frequent postings, self-promotion and sarcasm. Females' style of talking, on the other hand, has two co-occurring aspects: supportiveness and attenuation. In a report included in the *ASEE Prism* Taylor (1997) cites a number of examples of conflicting and exclusionary discourse styles in engineering classrooms. For example, the 'devil's advocate' role is common among men, but is not comfortable for women who would rather cooperate and affirm. In one classroom, several engineering situations involving problem-solving were set up by adversarial-type interactions that involved the defender of an idea and an attacker, but this approach is seldom part of a women's verbal experience (32). In a later study [4], described in the same report, Hall and Resnick-Sandler claimed that in academic settings women are interrupted more often, that their contributions are mistakenly attributed to others, or to luck more often than men's, and they receive less attention and encouragement from instructors (30). This difference appears to be sustained in the roles people take in online conversations. Women will behave consistently with maintenance of socio-emotional group process roles and men will behave consistently with a task-oriented role (Savicki et. al., 1996).

Although many institutions have developed strong policies for pornography and harassment, it continues to be a problem. Women must be cautious about publishing any information about themselves. Men have adopted female pseudonyms in order to belong to restricted conversations and once included then have harassed participants for their views. Some women have also enjoyed more credibility by using male pseudonyms (Turkle 1995).

Herring (1996) found that in studies of Internet discussion groups involving both women and men, men contributed more consistently than did women. In fact, if women contributed more than 30% of the conversation, they were perceived to be dominating the conversation, by both men and women. These findings have been supported in more recent studies (c.f., Blum 1998).

Inclusive design solutions

In the classroom, many of these problems can be addressed by a discussion of social protocols online, a conversation during which all participants consider the effects of lack of social cues. Issues to be discussed may include identity, language use and tone, acceptable ways to disagree with or challenge the views of others, and length and number of postings. In some cases, the use of pseudonyms is acceptable, although anonymous postings can encourage inappropriate, even abusive behavior. Because one often chooses to use CMC as a way to build learning communities, facilitator modeling and support for diverse views and experiences, expressed in safety, must be explicit. Swift interventions are essential when interactions go awry.

[4] *The Chilly Classroom Climate: a Guide to Improving the Education of Women* (1996)

The Internet can bring women together in communities across national and cultural boundaries, can enhance women's creative potential, and can provide an opportunity to extend or re-define one's gender identity. Formerly inaccessible information sources are available to share through online support structures. Hypertext writing and CMC may encourage the building of online, activist communities for social justice. Online environments may be empowering for women if/when they support connected, inter-relational, collaborative, and non-linear learning. Indeed, such innovations promise the most equitable context yet for learning about and through computer technology.

ACCESS

The issues

The issue of access to computers and, by extension, information, is of central concern as numerous studies have shown that computer ownership and computer use is predominantly male, likewise the pattern of online use and access (Balka and Doucette 1994). Unequal access begins in the home and at school, ranging from a 2:1 ratio to a 3:1 ratio in favor of male ownership of computers (Gilbert and Kile 1996; Spenneman 1996)[5]. The ratios increase, too, when the <u>kind</u> of computer is considered[6]. Spenneman (1996) speculates that the level of computer ownership and use reflects the socioeconomic differential between men and women in the industrialized world.

Gender differences in access to computer technology spill onto a variety of related issues. Males tend to participate in more informal computing experiences than females and feel more comfortable with technology (Spenneman 1996). Access relates directly to experience by influencing attitude and achievement (c.f. Liao 1999). Unless we address these inequities, women and other marginalized groups are in danger of becoming "the disappeared" in educational, economic, and employment initiatives that rely on computer technologies (Shade 1997; Winkelman 1997).

For instance, distance education is one area in which access is of paramount concern to educators. As traditional institutions make more flexible options available for off-campus students, equitable access becomes an effective gatekeeper. High percentages of distance, and/or non-traditional learners are women. von Prummer (1993) cites funding as a problem for this group, as well as lack of institutional support for the family issues that concern women. Women may have different needs for support than men, but their needs are often dismissed as unaddressible by the institution.

This lack of support translates into inflexible schedules and deadlines for assignments and exams, requirements for technological tools that may be out of their economic reach,

[5] Figures vary wildly in this area and must be evaluated in light of the context in which they are quoted. For example, Sadie Plant, as a notable exception, estimates female Internet usage at 50% of the total users (Millar 1998).
[6] In Speeneman's study, for example, 48.6% of males and only 6.3% of females had World Wide Web (WWW) capable computers

designs for the solitary learner that are uncomfortable for women, and learning activities that may require travel, extra fees, and special arrangements, such as videoconferencing.

Their families and other social structures in the community may marginalize women who are otherwise candidates for distance learning (Burge 1990, 1994; von Prummer 1995). Von Prummer characterizes this marginalization as "sabotage" by family and friends, including the destruction of materials, increased demands for attention and help, “guilt-tripping,” and refusing to set aside time or space in the home for study.[7] Ironically, women may place higher demands and standards on themselves to compensate for self-perceived "selfishness" in pursuing their goals and interests.

Inclusive design solutions

The issue of access is a widespread and globally political one that resists simplistic formulations and solutions, but we can try to minimize inequitable access among our own students. As post-secondary institutions wrestle with the notion of flexible learning and the "laptop university," a number of creative approaches are possible.

Several institutions have experimented with "rent-to-own" or "work-to-own," leasing, "evergreening" and interest-free loan programs, among them Wake Forest University. (See http://www.wfu.edu/Computer-information/thinkpad/2000.htm)[8] In Alberta, a consortium of post-secondary institutions formed "Alberta North," to develop and foster community-based learning centers with guaranteed access to standardized learning technologies.

On-campus, too , access for women can be improved through:
- required computer literacy classes for all students
- location of computing facilities in campus areas where women learners and women faculty members are concentrated
- designated "women-only" lab time, with a less competitive climate and more personal interactions around problem solving and computer anxieties
- same-sex computer classes, as one learning option available to women students who would like it
- alternative designs of computer spaces, such as pods of four to encourage cooperative work
- computing facilities that are supervised at all times, or especially in the evenings

[7] I witnessed this phenomenon first-hand as a distance educator working with First Nations communities in northern Manitoba, in 1995. For example, female adult learners would be denied childcare assistance by their families, without which they could not continue studying.
[8] This initiative, and others, were described at a panel at The *International Conference on Computers in Education* (1998, October), Beijing, China. Full reference included in the Reference section.

NEW DESIGN TOOLS AND APPROACHES

In *The Social Construction of Computers* (Kirkup and Keller 1992), Sherry Turkle speaks of technological environments in the 1990s as "a new social construction," in which we are freed from the social conventions of specific cultures, professional or personal roles, and gender. In these environments the cultural context in which knowledge was produced is examined with the questions *whose authority?* and *whose knowledge?* as critical lenses. Learners are encouraged to use their own feelings, intuition and imagination as resources and strengths for learning as they work towards self-empowerment. Designs based on cognitive flexibility (Spiro et.al., 1988) encourage learners to "crisscross the landscape" of multiple perspectives and constructions of reality, so that learning based on social interaction helps clarify meanings and achieve consensus (Stacey, 1999). These kinds of relational designs include problem-based and case-based models in which learners work together to gather evidence to support critical solutions. Social discourse is central to this process, and is often supported through asynchronous means such as online conversations or threaded discussions, or synchronous conversations through audio or video conferencing.

At the University of Alberta, we have designed and delivered numerous courses that reflect inclusive design guidelines. For example, "Interpretive Inquiry: Hermeneutic Phenomenology", a graduate nursing course, includes a mix of technologies and activities. We provided participants with a number of issues, or anchors, related to bioethics. The issues were presented through multiple representations: readings, links to medical research sites, a videotape of a simulated genetic counseling session, and a television episode of the series, "Law and Order." The students, who were from Guam, Thailand, Canada, and the United States, reflected on the nature of embodied knowledge (a phenomenological concept) by following a videotaped yoga lesson, and shared stories of health practices. They joined threaded issues-based online discussions, completed a cooperative project, which they negotiated with one another through a synchronous chat room, and participated in three audioconferences. Although several students encountered technical problems, and thus found it difficult to participate consistently, most were actively engaged by the mix of approaches. A community emerged from their experiences and they have continued their network of personal and professional relationships online beyond the classroom.

The University of Alberta project is one attempt to fully utilize the educational potential of computer technologies to create an inclusive environment for learning; but there are too few models available to us to address the persisting gender inequality in technology-based learning experiences. Designs limited by over-reliance on male-centered experiences have constrained the development of innovative approaches to content, design environments, learning strategies, and access considerations. With the advent of networked technologies and new instructional models, women have an improved chance of learning in more interconnected, authentic, and relational ways. Scholarship from women's and gender studies is a valuable and underutilized resource for the development of computer-based learning technologies. If we are aware of exclusionary learning designs and environments, and consciously adapt new teaching strategies and processes to address inequities, then all of us - teachers and students - can make the most of our educational settings and opportunities.

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[i] Schiller, Wylie, and others have cautioned that since North American sites dominate the Internet and information, language and its cultural representations should be of concern to those designing for inclusivity.

[ii] Advisement typically provides advice like the optimal path through the lesson, the appropriate lesson sequence, or the optimal amount of instruction. Clariana noted that females that received advisement completed more sessions than either the females with no-advisement, or the males with or without advisement. In other words, advisement may be more frequently sought and more effectively used by females than by males, since there seems to be a relationship between achievement and motivational effects for women.