

# Space Aliens?

## Women, ICTs, and Gender-equitable Electronic Resources \*

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Virtual gender is the result of a complex interaction between culture and computer technology. Computer hardware, network connections, and software place constraints on how people can relate to each other. Virtual gender is therefore a technology-dependent phenomenon. The social construction of gender is very obvious in the virtual computer interaction medium.

Christine H. Jazwinski, Gender Identities on the World Wide Web

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*This paper explores some of the critical issues surrounding gender and technology, examines what they mean for teaching and learning online, and then describes two projects at the Gender and Diversities Institute at EDC. The first project is research on online learning and its links to gender equity. The second project builds on this base to create a gender and science digital library. Both reflect the work of the Gender and Diversities Institute as it tries to determine how best to create web-based resources and materials that value gender and diversity and support the learning needs of different groups of women. To do this we are exploring a number of questions as we seek to create empowering Internet resources and services for formal and informal educators, for researchers, and for students.*

□ In the United States, it often seems as if everyone is a walking technology advertisement. People stroll down the street talking on cell phones; they e-mail their families and friends; they research health and wellness questions on the Internet; and they purchase clothing, food, and other goods online. In school, many children routinely use computers while at home they play computer games or spend time in chat rooms. Toddlers and young children play with toy computers and computerized games and even carry toy cell phones. Indeed, within this highly industrialized nation, there is a technology revolution going on, forcing changes not imagined even five years ago. We have access to untold amounts of information and unimaginable numbers of people.

We also face serious challenges: the digital divide that threatens to create deeper economic and social divisions between poor and rich; privacy, safety, and security concerns where personal information is easily obtained; cyber-attacks in which individuals are harassed or entire systems disabled; and questions about authenticity and reliability of documents and conversations. The new technologies bring about a change in the social, political, and cultural dynamics of the country. Instant news, instant connections, and the opportunity to build bridges with people anywhere eliminates barriers of race, culture, gender, but raises concerns about maintaining relationships with the person

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The work described here is supported by grants from the National Science Foundation, especially the Programs for Gender Equity (#0002126), which funded GEMS: Gender Equity in Online Learning, and the Division of Undergraduate Education (0121677), which funds the Gender and Science Digital Library. The opinions expressed here are solely those of the author and are not meant to reflect those of the National Science Foundation.

next door. For example, talking with "like-minded" people from around the world can be the basis for a new community, with which one can more easily identify. This ease of entry and community building could easily curtail what could be the more difficult task of community building with the individuals that share one's physical space but who may not have easy access to online communication. Or, ICTs could support the development of a community of neighbors by providing an electronic equivalent to the "front stoop," the backyard fence, or corner store where communities traditionally congregated.

Within all this remains an age-old concern: where are the women? Are they "space aliens" who have difficulty traveling through cyberspace, are they seen as interlopers in a man's world, are they conforming to age-old gender-role stereotypes, are they actively defining the Internet and information communication technologies (ICT) as their own? The answer to all these questions is yes. There are some indications that the Internet is providing positive opportunities for women and men to communicate differently, for women to build new models of community, and for ICT to enhance teaching and learning. Overall, however, this remains uncharted territory. Gender and diversities play a critical role in the development and use of technology, but are often overlooked or ignored.

The social construct of gender carries beliefs, values, and stereotypes expressed through the use of language, inter-personal and public interactions, within the various media of movies, radios, CDs, and television, and in written text. Computers and the virtual world present another medium and context with gender considerations and implications. Imagine what it would be like if gender, race, ethnicity, and other facets of human identity were core values in the design of online resources and services. Imagine what it would be like if equity and justice were guiding principles in the development of programs and resources. Imagine what the Internet would look like and feel like if it reflected a multicultural perspective, giving voice and face to a wide range of peoples. Imagine what would happen if people were able to choose the impact and level of technology integration in their lives.

#### BACKGROUND

Technology and its use exist within the context of a culture; both the school culture and the

larger culture exemplify norms, values, and beliefs that form our attitudes and behaviors. Throughout history "technology" has referred to the tools and systems with which humans control their lives. Frey (1989) defines technology as object (tools, machines), process (design and transformation of material), knowledge (know-how, technique), and volition (aims, intentions, and choices that link the other three). Musical instruments, forks, pencils, and shovels constitute technology as much as lasers and computers. Postman (1992) points out the design of the technology, in this case computers, both reflects the thought processes and perceptions of the designers and influences the way users think and construct their world. If as Postman suggests, the design of a technology reflects the thinking and learning style of the designer, the users of that technology would most likely learn to work within the original framework. If this is a linear, sequential process, then users may begin to assume that process as appropriate, eliminating the expectation of or comfort with other thinking processes. In other words, the technology would train us to think and respond only in certain ways. However, to date little research has looked at the concept mapping or paradigm of programmers and software developers and the impact this has on the design of technology tools or on the end user. This is particularly important as most people within ICT are males--and in the United States, predominantly white males, who primarily are trained in one technology paradigm (which grew out of the initial military research and application processes for technology). For example, among recent graduates (after 1990), women represented only 30 percent of the science and engineering labor force and about 27 percent of the computer scientists--a number that has been declining steadily (NSF, 2000). Women of color are extremely under-represented: Black and Hispanic women each were only 1 percent of science and engineering labor force, American Indian women were 0.1 percent and Asian women were 2 percent (NSF, 2000). This significant imbalance continues to support the replication of the original set of assumptions and processes, ones that force an alien culture on women who must choose to adapt or to leave technology/computing.

An examination of technology and its relationship to gender needs to consider the question, "To whom will technology give greater power and freedom? And whose power and

freedom will be reduced by it?" (Postman, 1992, p. 11). An early expectation in this society was that gender stereotyping, bias, and discrimination within technology would diminish following the development of microcomputers. As a new technology, computers had the potential to break the mold by becoming gender neutral. Instead, computers were quickly gender-typed as male territory and computer-related work was quickly gender-assigned. Word processing, as an extension of secretarial work, was "women's work," and designing software was "men's work." In many manufacturing industries, women were assigned to button-pushing work with computers while men were assigned jobs that "meddle with the works" by working with the mechanism itself (Cockburn, 1986).

Technology language itself became a way to build connections among males and to exclude females. Workplace research in the mid-1980s discovered that "men form relationships through, and thrive upon, the mutual exchange of knowledge and a humorous competitiveness concerning technology. . . . Men continually define women as not technological. By this dual process they create a highly masculine-gendered social environment and a woman who cannot fit into it." (Cockburn, 1986, p.77). In most instances, the power and freedom remains with those mainstream males who form the majority of the technology workplace and culture.

Gender differences in the paradigms that frame the ways that women and men perceive computers, technology, and their role within the lives of individuals, are established early (Brunner, 1999; Spender 1995). Men/boys and women/girls do see technology and computers differently. For example, one study found that girls preferred interaction with machines that provided help to others or connection with others, while boys saw computers as "extensions of instrumental power" that gave them control (Honey 1991). And, while girls have increased their computer and technology skills, they continue to choose other interests over ICT: it's not that they don't have the skills but rather that they don't want to be a part of the computer culture, a culture still defined as "white male." Thus all women, and men of color, are more often relegated to the role of user, rather than producer of ICT.

#### GOING ONLINE

Similarly, the virtual world largely remains a male domain. Overall, more men than women

are on the Internet. Women are only about one-third of Internet users in the United States and less than 20 percent of European users (Jazwinski, 2000; Graphics, Visualization, and Usability Center, 1998) and women were only about 20 percent of those considered most expert users. Access and control remain with men: as white males are the majority of designers, programmers, and ICT workers (Moran-Martin, 1998) and most system managers are men (Jazwinski, 2000).

Interestingly, the courses that we researched had a diverse group of women as content developers and facilitators and most of the participants were women. While this does not reflect the current statistics, it does indicate that women are increasingly becoming involved in all aspects of e-learning. However, at the same time it supports the assumption that women tend to concentrate in those areas they see as "safe" in terms of topics and behaviors. Our online participation of women mirrors that found in most in-person gender equity training and conversations, where women are the majority.

Conventional gender-roles are also evident in the virtual world of online communications, courses, and discussion forums. Blum (1999) found that female undergraduate students tended to place emphasis on relationships were empathic in nature, and would rather learn in a cooperative rather than competitive environment. Women's language tends to have attenuated assertions, include apologies, explicit justifications and questions; is more personal, and usually seeks to provide support to others (Herring, 1993).

Male students preferred more autonomous learning, exhibited a more controlling nature, and were assertive in their communications (Blum, 1999). Men's aggressiveness can discourage women from participating while women's politeness can be seen as a waste of time by men (Herring, 1996) or as censorship (Grossman, 1997). However, while men's language tends to have strong assertions, is self-promoting or sarcastic, there is some evidence that the anonymity of the Internet does enable them to try out non-stereotyped and more empathetic dialogue styles (Jazwinski, 2000). Males more often "try out" other aspects of human identity by gender bending (Burn, 1996) while women are more likely to hide gender identity.

In the US, males, usually white, have higher earning power and more leadership positions--

and thus have higher status. This carries over into the conversations of the Internet. Higher-status people talk more and are more influential in small groups according to research by Deaux and LaFrance (1998). If this is the case and if men are more numerous on the Internet, they would assume control of conversations. The conventional masculine use of confrontation and women's tendency toward harmony can lead to conflicting experiences online.

These distinctions, however, must be carefully examined. Participants from different racial/ethnic groups may use different communication styles and much of the current research on online communications focuses on white participants from highly industrialized countries, as this is still the majority of users. And even within the United States, there are significant disparities of Internet access and large numbers of individuals and groups either do not have ready access to high-end technologies and/or cannot afford them. As with the male/female hierarchy, if the majority of participants in a discussion are white and middle class, they will recreate this position of power, unconsciously framing a conversation that essentially marginalizes or silences participants from other groups, thus mirroring face-to-face communications (King, 2000; Ferris, 1996) While the Internet does hold the promise of creating new relationships because there are no visual cues to trigger gender, race, or other stereotypes and biases, it is becoming clear that individuals and groups continue to provide such clues and to recreate power disparities in the virtual world. Status differences, in fact do not decrease (Sproull & Kiesler, 1991). Even with the lack of few cues, those remaining become salient and thus gender and gender-stereotypes will guide interactions within cyberspace (Jazwinski, 2000; Bodenhausen & Macrae, 1998; Fiske & Taylor, 1991).

Finally, the software and design of materials for the web can play a key role in creating comfortable environment for women. Currently most training and educational materials for the web are written by males and most web-based design documents do not address gender representation in language and general page design (Mahoney and Knupfer, 1997). The fact that materials and tools are designed primarily by males is not an indication of gender bias, but it does indicate that the tools will reflect the gendered and raced perceptions of the designers.

And it does raise questions about how the needs and perspectives of the end user are considered.

## GENDER-EQUITY AND E-LEARNING

Online learning is becoming the new educational alternative. By 2002, it was projected that an estimated 2.2 million Americans would be enrolled in distance/online learning (IDC, 1998). Many of these courses are for high school students, for university students, or for professional development. Most are focused on learning specific discipline related content, such as history of the American West, or skills, such as the techniques of developing online courses. The Gender and Diversities Institute began its involvement in online learning from a different perspective. It sought to create online learning focused on affective issues, on reflection, and on discussion of issues related to equitable education.

The first GDI online course was developed by its Women's Educational Equity Act (WEEA) Resource Center project. Development of this course reflects a mandate to promote gender equitable education nationally, and particularly to provide assistance directly to schools in meeting this goal. The online courses are a way to reach more clients, especially those who can not participate in onsite training and who experience increasing demands on their time and attention. The content for the course drew directly from requests from the center's existing client base.

This course, *Engaging Middle School Girls in Math and Science*, includes eight sessions that introduce basic gender equity concepts, tools, and resources in a math and science classroom context. The first seven sessions focus on a specific aspect of incorporating gender equitable instruction in the math or science classroom and into community and family interactions. Each session is designed to build on the previous one. Each contains a lengthy written discussion of research, offers a number of hands-on activities for the classroom, and guides self-reflection and interactions through a series of key questions. Each session moves the participant toward an increasingly deeper understanding of one's early experiences and the influence on their behaviors/beliefs as adults, the way they reinforce these in the classroom, and about one's current stereotypes, beliefs, and biases about students, and about math, and science teaching/learning. The final session is devoted to

final presentations and discussion among the participants about these.

A closed discussion area, a safe space for participants to talk about the issues, is where the "real" learning takes place, as we believe that it is the dialogue among participants that helps shape deeper learning. In this instance, this means that participants expand their knowledge and deepen their understanding through interactions with others. Here, guided by a facilitator who plays a "guide" role, participants reflect on their activities and readings, ask questions, and respond to one another. Participants discuss the readings, their experiences in trying out activities, and the connections between course content and their practice experience. The course facilitator plays a vital role in the course, monitoring discussion, encouraging participation, posting session previews and summaries, and highlighting the common threads that run throughout the course's various sessions.

The course surfaced a number of challenges. One challenge we faced was achieving the right balance between flexibility and structure. A number of participants said they registered for the course because of its perceived flexibility, especially in terms of time. We learned that many participants needed to feel pushed or prodded in order to be motivated to do the readings and enter the discussion. Others, feeling the crush of time or unable to organize their own learning effectively, required additional structure and external motivation, or they simply disappeared from the discussion. The revised course requirements and facilitator language are both more directive and explicit. For example, requirements now included at least three postings per session and these needed to include one original posting, one in response to another participant's comments, and one response to a response to one of their postings.

Promoting a sense of community has also been a challenge. We have found this to vary both as a result of techniques or tools we use as well as the dynamics that do or don't develop within the group based on their personality types and relationship with technology. While many courses have some face-to-face component, *Engaging Girls* does not. The development of this community or sense of connection as a way to strengthen learning and support different styles and needs had to be done completely within the virtual environment. The center tested

various ways of stimulating this group sense and found that the most effective approaches include a welcoming and inclusive facilitator tone, encouragement from her or him to respond among themselves, key questions to promote reflection and discussion, and a welcoming and intuitive technology. We also added a very hands-on tutorial focused on the technology itself, in order to help these first-time participants. We learned, however, that many still wanted and needed direct conversations with a "live person," preferably in person or by phone.

From the initial development of the course, we were concerned with the gendered and raced structure of software, course design, and online discussions. As we developed and then offered the course, we wondered about the technology itself and were we in fact recreating the situations we sought to change. In the process of developing the course staff focused on developing their own understanding of how gender and its intersections with race and ethnicity, socioeconomic class, disability, language, and other identities play out in e-learning. For instance, What does it mean to give gender equity training using a medium that is very gender charged? We wondered whether gender equity--a highly emotional and affective concern--could be discussed on line and whether it would have any impact on classroom practice or student outcomes. Our ongoing evaluations told us teachers enjoyed the course and said they learned a lot, but we wanted to really understand this process. Our questions soon also expanded to include the relationship of learning style to online learning.

## RESEARCH

With a grant from the National Science Foundation's Program for Gender Equity, we began a three-year research project to attempt to better understand the process of online learning and the role gender plays within that by focusing on the design, facilitation, and participation in Engaging Middle School Girls. This is a collaborative project, in which other partner organizations--TERC, Eisenhower National Clearinghouse, and WestEd, along with the WEEA Center--offered the course to a selected cohort. In this way we hoped to develop research cohorts that represented different regional groups of middle school teachers. However, the majority of participants in this research were from the Northeast states.

Our initial research questions included the following:

- Are teachers able to acquire knowledge of gender equity in mathematics and science through their participation in this course?
- Do teacher attitudes and/or behaviors change as a result of their participation in this course?
- Do student attitudes and/or behavior change as a result of the teacher's participation in the course?
- How is gender equity in math and science learned in an online environment?
- What influence does learning style have on the design and participation in online learning courses?

While the questions were later refined and we conducted our research, we have come to believe that such affective issues as gender equity can indeed be taught online and that this course does have an impact on teachers' attitudes and behaviors in the classroom.

Our research and analysis is being conducted with 49 participants and four facilitators from four cohorts. Although we had more participants register, a number dropped out or did not complete the required surveys or evaluations. Our final research analysis includes frequency and patterns of participation, interviews and site visits to selected participants, review of evaluations, and participant responses to a personality assessment instrument. We also used a case study methodology that focused on eight of the 49 participants.

Of the 49 participants, the majority were women and most of these were Caucasian. Participants ranged in age from early twenties to over 50 and most taught in predominantly white suburban or rural schools. About half were middle school teachers and the rest elementary, high school, or after-school teachers. Most were math teachers, while some taught both math and science. Almost all enrolled in the course to increase their knowledge and skills regarding equity, but none had taken an online course before.

Overall, the participants agreed that the combination of readings, activities, reflection, and discussion built an environment that enabled them to focus on their learning. It seems that different aspects of the course reflected different learning styles. Although there were some initial

difficulties with technology for a few participants, most quickly and easily got into the course. Discussion sections did not have a high degree of conversation, despite the requirements for posting. This may be similar to what many others have seen in online courses, where the ratio of facilitator to participant postings often shows the facilitator doing most of the "talking." In our courses, the participants do much more of the talking, but it remains at a low level. We do not know of any research that examines the amount of discussion in an on-site course with outcomes, nor do we know of any that compares the amount or content of on-site course discussions with those online, so there can be no determination about the quantity of discussion postings.

Within e-learning there are few differences between males and females in attitudes and achievements, whether they work with a partner or in a group. But when women work cooperatively with a partner, they are more interested in exchanging ideas and are more positive about their own performance (Savard et al. 1995). This collaborative process enhances collaborative interactions and reflections and increase student learning (Palloff & Pratt, 2001, 2000; Coy et al., 2000); Smith et al, 2001). This collaborative process was often evident in the discussions of women participants or was noted as a missing piece.

Despite what we felt was a low level of participation in the discussion section, the conversation was rich and varied, and the responses to the activities and guided reflections were often powerful, reflecting both personal experiences and professional concerns. For example, participants were initially asked to think about their earliest memories of mathematics or science. Surfacing such reflections is an important first step to understanding the role these early experiences have in shaping current beliefs. The memories came easily for many and often included stories of negative experiences as well as the power of good teaching, such as the following.

I definitely remember being divided up in 8th grade for math, and even making the "smart" group. However I also felt dumb as I wasn't developmentally ready to be in that group until later in high school. I bombed in Algebra I and especially II, though in Geometry, which was taught in a very concrete fashion, I did well with. I also bombed pre-calc until a single diagram of the unit circle changed my life, allowed me to understand what

trig was about and go on to do well with calculus. In science I have this incredibly strong memory of Mrs. Elsworth, in 7th grade, discussing osmosis. The question discussed was why someone left in the sea might die from dehydration if they didn't drown or get eaten by sharks.

In another activity, participants were encouraged to reflect on how their perceptions of students and of gender equity play out in their teaching and learning:

I too, am very interested in looking at my practices in terms of gender. I make an effort to override the loudness in males by reminding myself to preferentially call on females. Over the years my best students have almost always been female for both science and algebra. Though, when I taught lower level math did not find this to be the case. Currently I would include in my idea of top students, both the kids who get everything immediately and those that don't immediately, but struggle to get it. We alternate life and physical science by year and I see no difference between the two in terms of gender response to subject.

As participants moved through a process of facing greater complexity within the issues, the number of posting decreased. It is not clear if this is because of time constraints, lack of interest, or, a discomfort with examining such issues as personal power or working with families. We do know that other e-courses also see a drop in participation over time, and while men attribute this to lack of interest, women attribute this to a lack of time. But while the size of discussion slowed, insights and exchanges remained powerful. Personal power is often a difficult discussion for anyone, and especially for teachers and/or women. Perhaps the perception of anonymity helped participants explore this issue more easily online. For example, as one teacher reflected:

My personal definition of power is probably rather muddled. I hear the word and into my mind flashes the phrase "Power to the People." I would like to think that power and competence are or can be synonymous, but I know that in many ways they're not. We gain intellectual and material power as we gain knowledge, understanding, and competence in an area of learning, whether academic or nonacademic. The term authority conveys some of that sense of power conferred by knowledge and competence. Thus the cliched sayings arose that "knowledge is power," "literacy is power," "education is power."

Realistically, though, knowledge, understanding, and competence are not always enough, without opportunity. In our inequitable world system, power is often conferred not on the basis of competence but on the basis of gender, race, or socioeconomic status. Thus one might have the power to work effectively, but not be afforded the opportunity to do so. Power over others, based upon one's status, may not deserve to exist, but it sure does... race, gender, or socioeconomic status make it less possible for many people to effectively realize their power with ideas, knowledge, and skills in testing situations. So here we are in our classrooms, trying to create situations in which power equates with competence and students' competence is nurtured so that it flourishes and their power grows. Meanwhile, our classrooms are surrounded by and affected by a world in which power is more equated with status. Our students come to us ready to grab power (both power over and power with) or to concede it to others. Some of them come to us filled with the knowledge of their competence and power while others come to us filled with uncertainty and even denial about their competence and power. It's quite a task we've got.

Participants exhibited thoughtful discussions, feeling safe to talk on a level they may not with their workplace colleagues. As one participant later said in an interview, "I liked the discussion section. It was a safe place for me to talk about my students without one of my colleagues saying, 'oh that wasn't my experience' or 'what about such and such?' I liked having the chance to work some of this stuff out with teachers who didn't have preconceptions of who I was or who my students were."

The participants in the case study reflected the majority of participant evaluations as they made references to the importance of talking with others who they saw as peers. On their evaluations many of the participants said they wanted to meet the other participants and still others felt this was a small community, all supporting Borg's (1996) assertion that women need to build community to feel safe online.

While the participants built dialogue and learned from their own reflections and from one another, the facilitator's role was less clear. While trying to be a "guide" rather than lecturer, the facilitators often began the discussions with the guiding questions, offered support, and tried to keep the conversation focused. At times they provided a good blend of thoughtful inquiry or authority and at others they were almost invisible, sometimes overlooking the teachable

moment. This points to the need to do significant training with online facilitators who, while they may be good trainers/educators on-site, are still entering a new environment with different requirements for the teacher.

Following the initial analysis of the discussion, we developed a series of case studies and a cross-case analysis that details the experiences and reflections of eight participants. These case studies drew from the evaluations, the online discussions, site-visits, and classroom observations.

We are now in the process of completing the cross-case analysis and beginning a second level of discourse analysis that will help us to further determine the roles participants played in the development of the online learning communities. In our initial analysis, we did see that the participants in the case studies, which were 7 women and one man, did in fact seem to replicate the gender-assigned conversation roles that we mentioned earlier. For the most part, there was little overt disagreement or fractionalization. However, one participant said she would like to have disagreed with some others, but felt she didn't have permission to do so from the facilitator or the environment. While one recommendation from our research is to make sure we set a tone where people can disagree safely, it is interesting that she needed permission from someone else to disagree, as disagreement might have been seen as outside the accepted parameters of the conversation, something I am not sure would have been the case with most men. However, if we are to make women feel comfortable in the online setting, this is an important consideration.

As we continue our research, we will also develop a series of guidelines and documents for the development of equitable online courses and for equitable facilitation online.

#### **GENDER & SCIENCE DIGITAL LIBRARY**

As we explored the experiences of women in this online course, we also began to envision other venues for education, such as the development of a digital library. A relatively new development, digital (or electronic) libraries are comprehensive and interactive collections of electronic materials (books, articles, videos, online tools, etc) that can be searched, accessed, and used. Imagine a large public or private library, extending around the world, but now available at your fingertips,

with a friendly reference librarian there to help you find what you are looking for.

Building on our experience with the online courses and our research, we began to create the Gender and Science Digital Library (GSDL), funded by the National Science Foundation. Still in its development stage, the GSDL will be launched as part of the National STEM Digital Library later in 2002.

Many of the existing digital libraries are devoted to a specific field, such as engineering, teacher development, or Greek culture. While designs differ, users can search on the library collection, often interact with different electronic items, download materials, interact with experts, other teachers, or other interested individuals. There are often places to share newly developed materials or to critique existing resources.

The GSDL remains unique in that it cross all boundaries with its focus on gender. It therefore is cross-disciplinary and multicultural. It can unite K-12 teachers and students with university researchers, it can bring un-thought-of materials on women's contributions to science to university educators, and it can be a place to examine just how gender impacts both the design of and use of science.

As we envisioned it, the Gender and Science Digital Library for K-16 will:

Search out, evaluate, and classify the many existing resources and materials that apply to the broad areas of gender and science

Create an interactive protocol that helps users find and use the resources within the library, and that will guide developers and publishers in the submission of future materials

Determine those areas of curriculum, research, and other resources that are not well covered for future development

We proposed to construct such a library in order to disseminate good teaching materials, improve the general quality of gender-fair science instruction materials, and form a set of shared resources for teachers and students. Core holdings of the library will bring together the print, electronic, Internet, and people resources to support gender equitable science that have been developed over the past decades. Since this library is designed to support teachers, of primary importance is an interface that allows users to quickly discover what they need, when they need it. This project will adapt existing



technology to allow for rapid implementation and a smooth interface with other digital libraries. A full range of digital and human services will support users of the library, facilitate creation of new quality materials, and promote implementation of gender-equitable practices in science education. While this project will begin with a core collection and services geared primarily to K-12 science educators and to teacher educators, this library will evolve over time to incorporate additional resources and respond to changing education needs and technologies. We will be proactive in building user and developer communities and in establishing relationships with other digital and science/gender equity education efforts.

The concept of a digital library for gender and science stems from a growing request for better access to high quality materials related to gender and science at all levels of education as well as the desire to create a more effective dissemination system for the products and research that have been developed. A digital library offers instantaneous dissemination of information, personalized search capabilities, and a virtual community of users. Several factors have created both a strong need for a gender and science digital library and the environment for its construction:

- an increased educational emphasis on student understanding of science
- national mandates to improve science education at all levels and to increase girls' science achievement and career choosing
- development of the technical tools and infrastructures for digital libraries

The design of the GSDL had to begin with the end user. What did those who would use the GSDL want: in terms of materials, in terms of services, in terms of searches, in terms of design. The library began its initial phase with a series of focus groups and meetings with different stakeholder groups. These helped us to determine how different people would construct a search for materials and information, how they would like that information displayed, and what they wanted to get when they did a search.

Drawing on this information, we began work with our partners at the Eisenhower National Clearinghouse to develop the site. At the same time, we began to collect resources and materials that were electronically available: from other websites, from online journals, and from

publishers and others who would provide materials in electronic form. These are reviewed for both science and for gender equity content, measured against criteria established by our advisory group and verified by others in the field. Those accepted are then entered into the library and tagged with meta-data (a system of notations that help the database retrieve the specified item or part of the item).

We will be testing the site design and contents during the fall of 2002 and making final design changes to ensure that it meets the needs of a wide range of audiences. As it is launched we will continue to solicit materials and resources for the library, which will have free and open access.

As we move ahead with the development of the GSDL, a number of challenges continue to face us. How to we reach a wide range of end users to let them know about the library. How to continue to add resources, especially those that strengthen the inter-disciplinary and multicultural perspective of the GSDL. How to help end users actually use the materials in ways that improve education in classrooms. How to build a multi-lingual and multi-national resource that can serve as a bridge among the different sciences and among educators, researchers, teacher preparation faculty, professional development staff, informal educators, and families. Finally, and most importantly, how does the GSDL help to make gender issues mainstream within the science and education disciplines?

And, as we develop this resource, we are still learning about how to align the conceptualization and use processes of educators with those of the designers. This has led to a new research project, one that is just beginning. Funded again by the National Science Foundation, this research will help us to better understand how teachers design their questions in relation to the requirements of their classrooms and curricula, how they go about searching for materials on the Internet, and what they do with these materials in the classroom.

Each of these projects will add a new dimension to understanding the role gender plays in the design, development, and use of the Internet and its resources. With this understanding, we and others, hopefully will be able to think outside the box of existing technologies and uses, and develop resources that truly meet the needs, values, and interests of women. □

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