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Portrayals of information and communication technology on World Wide Web sites for girls

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Abstract

This study reports a content analysis of 35 World Wide Web sites that included in their mission the goal of engaging girls with information and communication technology (ICT). It finds that sites emphasize cultural and economic uses of ICT, doing little to foster civic applications that could empower girls as citizens of the information age. The study also finds that sites foster a narrow range of ICT proficiencies, focusing mostly on areas such as communication, in which girls have already achieved parity with boys. An examination of the role models portrayed in ICT occupations indicates that the sites show females mainly in elite technology jobs, reversing stereotypical mass media depictions of females in low-status roles in relation to ICT. Employing an original index of ICT knowledge and skills, the study finds that the sites that scored highest both on fostering comprehensive knowledge and skills as well as featuring civic content were general interest web communities. Ownership (for-profit or not for-profit) of sites was less important than editorial control: Sites that offered girls a place to contribute their own content were more likely to offer civic material and a broader range of ICT knowledge and skills. We conclude with recommendations for web site designers to rethink their design strategies and their rationales for closing the gender gap in computing.

Introduction

The gender gap in the U.S. information and communication technology (ICT) work force has widened in the face of efforts to close it. The proportion of women in ICT jobs declined from a high of 41% in 1996 to 32.4% in 2004, and women still hold only 25.4 % of professional or management positions in these fields. Women's share of undergraduate degrees in computer science and engineering failed to grow from 1999 to 2004, holding steady at approximately 22 % (Information Technology Association of America, 2005). Harvard University President Lawrence Summers' widely-publicized remarks that women's lesser rates of leadership in scientific and technical fields stemmed in part from a lack of "innate ability," and the stormy reaction he provoked, have dramatized the continuing educational and occupational gender differences in math, some sciences, and engineering, including computer engineering (Begley, 2005).

From the late 1990s onward, many organizations created World Wide Web sites to boost girls' confidence with ICT and girls' interest in pursuing ICT-related careers. These efforts have attracted significant media coverage as well as corporate, foundation, and government funding. This study analyzes U.S.-based websites that included in their mission the goal of engaging girls with computer-related ICTs. Although a content study cannot establish whether these websites are successfully closing the gap in computing, such a study can tell us what kind of material sites attempt to introduce girls to online. We show the scope, as well as the limits, of what the websites teach about the uses of computers and related media, the types of ICT knowledge and skills that the websites foster, and the range of ICT occupations that the websites represent.

This study makes several contributions to our understanding of how the gender gap is conceived and represented. First, despite the importance of the issue for public policy, we

have found no systematic analysis of how these websites represent ICT in the literature, nor of other media examples aimed at engaging girls with ICT. Second, we propose and measure the presence of a new index of ICT knowledge and skills, synthesized from the literatures on education for ICT literacy and civic engagement. Third, our findings not only provide a basis for rethinking the design strategies of these websites to close the gender gap more effectively, but also encourage us to rethink our rationale for closing the gap by focusing not simply on economic and cultural reasons for girls to engage with ICT, but on civic reasons as well.

Literature Review

The Gender Gap and ICT

Technologies are often designated as falling primarily in masculine or feminine domains of use and expertise, although the gendering of technologies may change over time as marketers reposition them or users appropriate them for new purposes (Wajcman, 2004). The computer, particularly its designing, programming, and recreational/gaming aspects, was initially gendered male (Kiesler, Sproull, & Eccles, 1985; Turkle, 1988). So, too, was the early culture of the Internet, which was presented in the news media as a hostile place for women because of the prevalence of pornography, sexual harassment, cyberstalking, and aggressive communication in bulletin board systems (Edwards, 2005).

However, as computers have become connected to the Internet in large numbers, and so have became more useful for communication, some cyberfeminists have claimed that the technology now promises to deliver liberation, power, and pleasure to a new generation of women users, led by youthful "cybergrrrls" who have grown up online (e.g., Plant, 1998). In this view, women's abilities are advantaged by the new technoculture and workplace because they reward intelligence more than physical strength, democratic more than autocratic leadership, interpersonal skills, independence, and flexibility. Indeed, some historic differences in boys' and girls' uses of, and attitudes toward, computers appear to have disappeared. Men and women entering college report that they use computers frequently in almost equal numbers (Higher Education Research Institute, 2001). Women have gained parity with men in time spent using the Internet, with teenagers accounting for the fastest growing segment of female users (Horrigan, 2000).

Females' use of the Internet for communication now equals or outstrips males' in several ways. Women are more likely to use email to keep in touch with family members (Boneva, Kraut, & Frohlich, 2001). Girls aged 15-17, with strong needs for communication and social interaction, spend more time online than boys of the same ages and are more likely to use email, instant messaging, and text messaging via cell phones (Lenhart, Madden, & Hitlin, 2005; Valkenburg, 2004). The new generation of online interactive games appears to be drawing more female players than older computer and video console games (Graner Ray, 2004). A recent national survey found that 76% of girls who use the Internet have played an online game, compared with 86% of boys, although this does not necessarily mean that girls who play these games do so as frequently as boys (Lenhart et al., 2005). Another recent nationwide study of youths aged

8 to 18 confirms many of these trends (Roberts, Foehr, & Rideout, 2005). Researchers found no differences between boys and girls in their likelihood of being on the computer on a given day or the amount of time spent on the average day. However, the typical computer activities of boys and girls did vary: Boys were more likely to play games, while girls were more likely to use the computer for e-mail, instant messaging, and visiting websites. In addition, adult women continue to be well-represented in media production jobs, including digital content creation (Preston, 2005).

However, other gender differences in attitudes and uses persist. Recent studies of elementary and middle school children (Bruckman, Jensen, & DeBonte, 2002) and high school students (Barron, 2004; Colley & Comber, 2003) find that girls still report less experience with computer programming. Girls also continue to express less confidence in their computing and Internet abilities (Ames, 2003; Bunz, 2005; McIlroy, Bunting, Tierney & Gordon, 2001; Messineo & DeOllos, 2005; Torkzadeh & Van Dyke, 2002; Young, 2000). In addition, girls still demonstrate less interest in computers (American Association of University Women, 2000; Vale & Leder, 2004). The gaps in programming experience, confidence, and interest are also found between females and males enrolled in American university computer science and applied information technology majors (Ogan, Herring, Ahuja, & Robinson, 2005). Similar differences are found in Europe and Australia (for a review of this research, see Littleton & Hoyles, 2002). Women have been more likely to view the computer as a tool to accomplish tasks rather than an object of interest to be explored in its own right. Thus, females have been more likely to use computer applications for word processing, graphic design, and communication instead of tinkering, play, programming, or systems design (American Association of University Women, 2000; Jackson, Ervin, Gardner, & Schmitts, 2001; Odell, Korgen, Schumacher, & Delucchi, 2000; Scealy, Phillips, & Stevenson, 2002; Shaw & Gant, 2002). Furthermore, as noted at the beginning of this article, women remain scarce in ICT hardware and software design and engineering industries in the U.S., and in the higher degree pipelines that lead to these fields. Conversely, women remain highly over-represented in low-level ICT jobs in the U.S., where they comprised 80.3% of data entry keyers and 93.6 % of word processors and typists in 2003 (Preston, 2005, p. 15).

The persistence of some elements of the gender gap in ICT uses and attitudes underscores the importance of studying efforts to promote girls' interest in and uses of ICT, such as the websites examined in this study. However, it is just as important to examine whether these websites address current disparities in girls' uses and attitudes toward the technology, such as girls' continued avoidance of programming, or still focus on outdated disparities that have disappeared, such as girls' use of the Internet for communication.

Uses of ICT

In the literatures on the gender gap in computing and ICT, arguments for pursuing greater equity among males and females in ICT attitudes and uses are most often based on economic, cultural, or civic rationales (Raphael, 2002). These arguments need to be reviewed because each calls for a different kind of digital content aimed at closing the gender gap, which has implications for whether website designers should foster visitors'

economic, cultural, or civic uses of ICT on their websites. Indeed, each rationale suggests a different kind of gender gap that needs closing. These rationales also require some definition because the question of *why* we should seek to address gender inequalities is so infrequently examined in public discourse, which has been dominated by economic concerns.

Economic arguments for equality in ICT use stem from liberal feminist concerns about gender equity in schooling and the workplace (e.g., Furger, 1998) and industry demands for more trained employees (e.g., Information Technology Association of America, 2005). From this standpoint, closing the gender gap is primarily about equalizing women's opportunities to secure high-paying ICT work and secondarily about the social benefits of increasing females' control over technical design. This position often leads to calls for software and websites that feature female role models or mentors in the technical professions or that engage girls' interest in careers in the field. It is hoped that this strategy will counteract many girls' image of technical work as masculine, dull, sedentary, and anti-social, drawing more females into the educational pipeline toward advanced degrees and jobs in computer science and engineering (American Association of University Women, 2000; Cooper & Weaver, 2003).

Cultural arguments for equity focus on increasing females' opportunities to use technology to explore and express their identities, create, communicate, and maintain relationships. From this point of view, the gender gap is primarily a problem of unequal access to communication and play in the public and private spheres. The emphasis here is often on ensuring that girls have entertainment content, such as computer games, that suits their interests (Cassell & Jenkins, 1998), and on ensuring that girls have access to online communication and opportunities to create their own digital content via new media (Mazzarella, 2005). These arguments emerge mainly from scholars influenced by cultural studies and from female game and website designers (e.g., Graner Ray, 2004). As noted above, this aspect of the gender gap appears to be closing in several ways, as more women use ICT for communication via email, instant messaging, and text messaging, and continue to play a significant role in media production careers.

Civic arguments for equity stress the need for women to be fully informed and enfranchised citizens of the information age. This approach suggests that girls and women need to be able to use ICTs because they are increasingly important tools for engaging in civic life. It also maintains that females need to know how technology works to participate equally in designing, implementing, and regulating digital hardware, software, and content. From the civic standpoint, girls also need to know how computers work, in both their capabilities and limits, to develop personal and public codes of technology ethics, law, and policy. Girls need to develop critical thinking and ethical reasoning skills both *with* computers and *about* them. The civic rationale surfaces occasionally in policy discussions about technology in education (e.g., Alliance for Childhood, 2000; National Research Council, 1999) and more frequently in accounts of how women's civil society organizations are using the Internet as a space to organize for social change (Harcourt, 1999; Shade, 2002; Youngs, 2001).

Preparing girls for civic uses of ICT also appears urgent in light of widespread concerns about the civic disengagement of youth in general. Compared to prior generations of young people, today's youth express less interest in politics (Galston, 2004), are less likely to say that they trust their fellow citizens (Keeter, Zukin, Andolina, & Jenkins, 2002), and are less likely to define citizenship as involving duties (such as voting or donating money) and not simply rights (Kurtz, Rosenthal, & Zukin, 2003). Research on youth Internet usage offers some hope for the potential of new media to assist in re-engaging the young. Young people's introduction to the Internet coincides with a key moment in their political socialization. At the same time that almost all American youth are getting online, they are forming the political habits and views that will shape them as adults (Torney-Purta & Amadeo, 2003). Not only are 94% of American youth now online by twelfth grade, but they begin spending more time online and using the Internet in more ways on a regular basis during their teenage years, including for news and political information (Lenhart et al., 2005). For youth, the Internet can provide a "free space" for low-risk exploration of civic identities and alternatives to mainstream views across geographical and social group boundaries (Flanagan & Gallay, 2001).

The literature suggests that websites can make a contribution to gender equity by representing or featuring activities that foster girls' economic, cultural, or civic uses of ICTs. Because these uses have been emphasized differently in multiple branches of the literature, it is important to know whether websites are encouraging these uses equally, or whether some uses are neglected. In addition, because girls and women appear to have made the greatest strides in cultural uses of ICTs, ongoing emphasis on the cultural may make less of a contribution toward closing the gender gap than a focus on economic or civic uses.

ICT Knowledge, Skills, and Occupations

Digital media that aim to engage youth with ICTs can also be evaluated by examining what knowledge and skills necessary for ICT fluency are represented or fostered through activities in these media. There have been several attempts to define educational standards for ICT literacy in the U.S. (International Technology Education Association, 2000; National Academy of Engineering, 2002; National Research Council, 1999). It would not be feasible to assess whether websites address every type of skill and knowledge mentioned in the literature because there would be too many categories to operationalize. However, five overarching types of knowledge and skills may be synthesized from this literature: (a) a grasp of the technical aspects of ICT (hardware, software, tinkering, and troubleshooting); (b) social-ethical aspects (including such issues as civility, privacy, and intellectual property); (c) productivity-multimedia (such as presentation and web authoring software); (d) communication (including instant messaging and listservs); and (e) research (such as how to search for and evaluate information on the Internet).

Yet the literature on ICT literacy standards fails to reflect fully the technology's potential civic uses. Therefore, it is important to supplement the definition of core ICT knowledge and skills from the previous paragraph with categories from the literature on standards

for, and effective practices in, education for civic engagement (Kahne & Westheimer, 2003; National Assessment of Educational Progress, 1998). This literature also suggests several broad types of knowledge and skills for using ICT effectively, including for civic problem-solving and decision-making, project-based learning about civic issues, simulations of public life, opinion expression, deliberation, participation, and a grasp of the regulation of ICTs themselves. Examining the extent to which websites portray and foster a broad range of these kinds of knowledge and skills can indicate how successfully they are fulfilling their missions to develop girls' engagement with the technology.

In addition, many of the websites include information about ICT-related careers and female role models in them. The range of occupations represented on the sites is another indicator of their breadth of vision of the ICT field, as well as of their potential to overcome the legacy of mainstream media's stereotypical representations of women in relation to ICTs. Prior research on representations of females and computing in mass media indicate that women have often been portrayed in low-status and low-skilled occupations and roles in relation to the technology (Michaelson, 1994; Ware & Stuck, 1985; White & Kinnick, 2000).

For example, studies of print portrayals of computer advertisements found under-representation of women and extensive gender stereotyping. Ware and Stuck (1985) found twice as many images of men than women in magazine advertisements for computers. Women were underrepresented as managers, experts, and repair technicians, and over-represented as salespeople, clerical employees, and sex objects. Marshall and Bannon's (1988) study of computer magazines found that males comprised 68% of the individuals shown and that most females appeared not as the central figures in images, but as tokens mixed in larger groups of white males. Over 70% of the ads featured gender stereotyping of women in roles such as clerical employees or sex objects and men in managerial or executive positions. Similarly, in a sample of popular magazines and promotional materials about multimedia, Knupfer (1997) found most males were portrayed as using the technology to achieve success at work, while most females were shown in subordinate roles and not using the technology to advance their careers.

Depictions of gender roles with ICTs in advertising in other media appear to follow similar patterns. Knupfer (1998) found that a sample of World Wide Web banner advertisements tended to portray women as sex objects and in low-skilled roles in relation to information technology. When women appeared in the same or comparable type of advertisements as men, women were more often shown in subordinate roles. Comparable results emerged from a study of 351 prime-time television commercials aired during the 1998 season (White & Kinnick, 2000). Although the study found women were shown as computer users almost as often as men, women were significantly more likely than men to be depicted in non-professional occupations (such as secretary or telemarketer), and less likely than men to be portrayed as business professionals. Males were more likely to be shown as active computer users, while women were more likely to be portrayed as merely observing or passively standing by the machines. In light of these findings, it is important to examine the distribution of jobs portrayed on websites aimed

at involving girls with ICTs to see whether and how the websites are departing from the stereotypical occupational portrayals of women found in other media.

Research Questions

Based on the literature on the gender gap in computing, this study poses four broad research questions. To what extent do websites designed to engage girls with ICTs:

RQ1: Address economic, cultural, and civic uses of these technologies?

RQ2: Feature women in a broad range of ICT-related occupations?

RQ3: Foster a wide spectrum of information age knowledge and skills?

RQ4: Differ by ownership (for-profit, not-for-profit) and editorial control (by adults, by girls, and by both adults and girls)?

We inquire into whether websites differ according to type of ownership because of longstanding concerns that commercial media are less likely to provide the kinds of civic content needed for citizenship because doing so conflicts with the goal of profit-maximization (e.g., Baker, 1994). In addition, some research suggests that for-profit new media for women are more likely to construct women in narrow, traditional roles than nonprofit media (Strategies of Inclusion: Gender in the Information Society, 2004). We examine whether websites differed by type of editorial control, because it is important for effective media design to know whether girls and adults bring different expectations and emphases to the use of ICTs. We do not distinguish between sites controlled by adult males and females because only a handful of sites involved any contributions by males and no sites were controlled exclusively by adult males.

Methods

Sample

The sampling strategy involved controlling for language and nationality of websites by limiting the sample to sites in English created by organizations based in the U.S. and aimed primarily at U.S. girls. Websites were eligible for the study if their mission statement, "about us" page, or homepage identified girls aged 12 to 17 years old as a target audience and stated that part of their mission was aimed at engaging girls in using computer-based ICTs. ICTs included computers, electronic games, and the Internet, and websites were determined to be aimed at engaging girls with these media if they addressed girls as potential ICT users, designers, activists, donors, or community volunteers. Included in the sample were sections of sites devoted to cultivating girls' ICT knowledge and skills that were part of larger sites addressing a broader range of girls' interests (such as fashion, relationships, math, and science). Excluded were weblogs (blogs) and single news reports, few of which met the other criteria for the study.

Because of the vastness and transience of the World Wide Web, as well as the lack of any comprehensive tool for searching all of the websites available there, it is unlikely that any study can identify a full population of any kind of site (Stern, 2004). After experimenting with metasearch engines, search engines, and directories, we found directories to be the most useful both for eliminating irrelevant hits and including lesser-known sites. Thus, on September 24, 2004 we searched the following major directories and leading directories for youth: all Yahoo directories, Google – Kids and Teens Directory, Kid Sites.com – Girls Interests directory, Cantufind – Teen Girls directory (no longer available), Ask Jeeves 4 Kids, Kids Click, Yahooligans, and Joan Korenman's Websites for Girls directory. Search terms included computer and girl, gurl, and grrl; Internet and girl, gurl, and grrl; technology and girl, gurl, and grrl. Out of 808 initial hits, our final study population consisted of 35 websites, comprised of over 61,000 files amounting to about 2.2 gigabytes of data (see Table 1 for the list of websites.)

Site	Organization Type	Editorial Control
A Girl's World	Commercial	Adults
A Girl's World International Penpal Club	Commercial	Adults and Girls
American Girl	Commercial	Adults
ComputerGirl	Unclear	Adults
Design Your Future	Commercial	Adults and Girls
Engineer Girl	Nonprofit	Adults
Expanding Your Horizons	Nonprofit	Adults
Eyes to the Future – Speak Out	Nonprofit	Adults and Girls
Forum for Girls	Commercial	Girls
4 Girls Only	Nonprofit	Girls
GirlsGoTech.org	Nonprofit	Adults
GirLand	Commercial	Adults
GirlSite	Nonprofit	Adults and Girls
Girlstart.com	Commercial	Adults
Girl Zone	Commercial	Adults and Girls
Girls Are Powerful	Nonprofit	Adults
Girls Can Do	Commercial	Adults
Girls In Technology	Nonprofit	Adults and Girls
Girls, Inc.	Nonprofit	Adults and Girls
Grrl Gamer	Commercial	Adults
Girl Tech	Commercial	Adults
gURL.com	Commercial	Adults and Girls
Gurlwurld	Nonprofit	Girls
Imaginary Lines	Commercial	Adults
Purple Pyjamas (formerly Cyber Grrlz)	Nonprofit	Adults and Girls
The Role Model Project: Professional Women's Careers	Nonprofit	Adults
SmartGirl	Nonprofit	Adults
Super Sizzling Scientific Stuff for Girls	Nonprofit	Adults

TeleMentoring Young Women in Science, Engineering, & Computing	Nonprofit	Adults and Girls
Tomorrow's Women in Science and Technology (TWIST)	Nonprofit	Adults
Women in Engineering Organization	Nonprofit	Adults
Women in Technology	Nonprofit	Adults
Women of NASA	Government	Adults
WOW/EM (Women on the Web/ElectronMedia)	Nonprofit	Adults
Zoey's Room	Nonprofit	Adults

Table 1. ICT for girls sample websites

Three coders coded the websites online between November 2004 and January 2005. Most of the websites were not updated often, so differences in the date that each website was coded likely had little impact on the websites' content.

Measures

Using the website as the unit of analysis, the coding instrument measured the presence or absence on each website of content that addressed economic, cultural, and civic uses of ICT; a broad range of ICT knowledge and skills; information about ICT occupations; and site ownership and editorial control.

For ICT uses, coders looked for the presence of content on each website that fostered knowledge or skills dealing with economic, cultural, or civic uses of ICT. A website was coded as imparting *knowledge* if it featured either written descriptions on the website or links from the site to information on other sites about each kind of ICT use. A website was coded as developing *skills* if it offered step-by-step instructions on how to use ICT or interactive activities that allowed visitors to develop their abilities with ICT. For example, a website that described what an operating system does was coded as offering knowledge, while a website that featured an interactive game that allowed girls to tackle some basic computer programming tasks was coded as developing skills. A website that provided links to other websites that offered information about how to write html was coded as offering knowledge, while a website that itself gave a list of step-by-step instructions about how to write html was coded as fostering skills.

These uses of ICT were coded as *economic* if they included using the technology for a job or in clearly job-related education. *Cultural* uses referred to using ICT for self-expression, art, personal communication, or to engage with popular culture (such as for learning about fashion, music, films, or television programs). *Civic* uses were defined more broadly than in the traditional literature on media and political socialization, which has been critiqued by Buckingham (1997) for defining civic activity narrowly as participation in electoral politics, and for defining political socialization as inculcating support for the political system rather than examining it critically. Instead, we adapted a wider definition of civic uses of ICT from Montgomery, Gottlieb-Robles, and Larson (2004), which included use of ICT to participate in any of the following: voting on civic

issues, community service, philanthropy, global affairs/international understanding, journalism and media production about public affairs, political activism, promoting social harmony and tolerance, and engaging with social and political issues directly relevant to ICT (including the gender gap in ICT use). Coders also determined the type of use that was *primarily* fostered on the website, based on an examination of the most prominent parts of the website: the mission statement or "about us" page and the home page.

Coders also measured the presence or absence on each site of a long list of ICT knowledge and skills derived from the literature on ICT literacy. These covered the five main types of knowledge and skills introduced earlier: technical, social-ethical, productivity-multimedia, communication, and research. Table 2 presents a list of the categories and definitions of each type of ICT knowledge and skill, as well as selected examples.

Category	Additional Coding Definition	Examples Knowledge (description or links) and Skills (instructions or activities) concerning how to define, use, or design:
1. Technical		
Hardware	Any information or communication device with a chip or part of a network, or their internal components	PCs, PDAs, cell phones, TVs, servers, motherboards
Software	Any program running on a computer or network	Operating systems, applications, interfaces, compression and encryption programs, web browsers, network operating systems
Tinkering and Troubleshooting	Taking apart hardware or looking at software code to understand how it works; identifying or solving routine problems	Disassembly, identification, or repair of PC components
2. Social and Ethical		
Collaboration and Cooperation (on noncivic issues)	Supporting collaborative learning/welfare/happiness, or sharing experiences and advice	Mentors, professional and educational support groups and networking groups
Civility	Using civil discourse, not abusive language, when interacting with others	Chat room Netiquette
Privacy	Respecting and protecting privacy of others and oneself online (sites' privacy policies were excluded); not exploiting or impersonating other (real) people online	Protection of one's personal data online
Intellectual property	Respecting others' intellectual property	Not downloading copyrighted music
Intellectual honesty	Attributing others' work to them; avoiding plagiarism	Citing online sources
3. Productivity and Multimedia		
Graphics, art, presentation software	Creating graphics files	Microsoft Powerpoint
Web authoring	Creating web pages	Macromedia Dreamweaver
Digital photography, video, audio, radio	Producing these digital media	Internet radio

Spreadsheets	Manipulating numeric data	Microsoft Excel
Word processing	Manipulating written symbols	Microsoft Word
4. Communication		
Email account	Account for sending and receiving private messages via the Internet	Email accounts and features
Listservs	Program that distributes subscribers' contributions to common discussion to all other subscribers via e-mail	Listservs
Chat room	Space on web site for real-time discussion of common topics	Chat rooms
Online forums and submissions	Any feature that allows users to post messages on a site	Message boards, online conferencing, user-written articles, letters to editor, advice columns, reviews on stable pages of site (not chat room, listserv, etc.)
Instant messaging (IM)	Real-time text-based communication via an IM program	AOL Instant Messenger
Text messaging (SMS)	Real-time messages sent via cell phone, PDA or pager	Text messaging
Online interactive game	Includes individual or multiplayer games	MUDs, puzzles
Virtual reality (VR) environments	Computer-generated environment with which users can interact using specialized peripherals such as data gloves or head-mounted displays	VR arcade games
Poll (on noncivic issues)	Users' expression of views as a vote" for pre-given response	Polls on favorite musicians
5. Research	How to use ICTs to learn about the world	Internet searching; graphing or modeling data with ICTs
6. Civic		
Problem Solving and Decision-making	Helping to solve real-world civic problems (not individual problems) or making decisions or taking actions that affect civic realm (not private, or individual self-help)	Mentoring girls to close the gender gap in computing
Collaborative learning	Learning with others about civic issues	Work with peers to research community problems online
Project-based learning	Learning about civic issues through online or offline projects	Research and presentations on environmental quality
Simulations	Learning through games or role-playing exercises based on a simplified model of a real-world situation	Exercises involving conflict resolution, diplomacy
Speech	Online or offline expression of opinion	Civic petitions, civic polls, letters to editor
Deliberation	Active *discussion* of policy options with others	Discussions in listservs, chat rooms, message boards
Participation	Connecting with adult role models or peers to engage in civic action online or offline	Fundraising drives, campaigns, demonstrations
Regulation and policy	How regulation or policy is shaped (by government, citizen groups, corporations, etc.); how cultural, economic, political factors shape ICT design, and vice-versa	Mutual influences of Internet and privacy, intellectual property, or free speech laws; law enforcement in cyberspace (against spam, identity theft)

Table 2. Categories of analysis for ICT knowledge and skills

If a website included any statement that conveyed even basic information about one of our categories, it was coded as offering knowledge. For example, although a website that merely mentioned the word "Dreamweaver" would not have been coded as offering knowledge about web authoring (in the larger category of productivity-multimedia), a website that included the statement "Dreamweaver is a program used to create web pages" would have been coded as providing this kind of knowledge.

Coders also searched for mentions of 10 ICT occupations by using Google's keyword search function to search the websites for the words listed in boldface in Table 3. The jobs were chosen to reflect a broad spectrum of occupational status in the industry, from executives to data entry operators, in order to examine whether the sites were departing from past mass media stereotyping of women in low-status ICT jobs.

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1. Executive/Officer/Founder/President/Vice-President/Director

2. Researcher/Professor: Research Scientist (corporate, government or academic), Computer Science Professor, etc.

3. Manager/Leader/Webmaster: Project Managers/Leaders/Directors, Webmasters, etc.

4. Administrator/Analyst/Engineer: Network, Database, Systems, Web, etc.

5. Programmer: Network, Database, Systems, Web, etc.

6. Graphic designer/Web designer/Animator/Writer/Game developer/Composer: non-managerial media producers

7. Technical writer: of manuals, documentation for users, etc.

8. Customer support/Computer support: non-managerial call-center or on-site support, etc.

9. Sales/Marketing/Public relations/Community relations: non-managerial

10. Technician/Operator: installation, maintenance, repair, computer operator, data entry

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Table 3. ICT occupations coded

Two additional defining features of the websites were also measured. Ownership was established according to whether a website's domain name ended in .com (for for-profit websites) or in .edu, .gov, .org, or .net (for not for-profit websites). However, two

websites that ended in .com but were created by nonprofit organizations and had no advertising were coded as not for-profit, and one website was coded as unclear. Editorial control of a website was gauged by examining the ages of those identified in the "about us" or "credits" pages of the site as responsible for its design as well as by looking at interactive features (such as message boards). Websites were coded as created *by adults* if credits indicated that the designers were all 18 years of age and above and if fewer than two-thirds of the postings to interactive areas of the site were created by girls 17 and younger. Websites were coded as created *by girls* if the same indicators suggested that the website was created exclusively by a girl or girls. Websites were coded as created *by both adults and girls* if credits indicated that the website was created by at least one girl and at least one adult, and girl-created content made up at least one-third of the website. For example, an e-zine created by adults that mostly featured girls' writings was counted as created by both adults and girls.

Intercoder Reliability

All coders used Internet Explorer 6.0 to minimize differences in the appearance of websites due to web browser software. After the three coders spent over 20 hours in training on the coding sheet, seven websites (20% of the sample) were randomly selected for a test of intercoder reliability. With two exceptions, all of the variables reported here reached 80% agreement or above, as averaged across the three coders. Two of the coding categories for technology-related careers earned 71% agreement: the category for non-managerial media producer (including graphic or web designer, animator, writer, or game developer), and the category of technician/operator. Across all variables in the study, percent agreement averaged 91.7%. Because of the small study population of 35 websites, data from the websites used to test intercoder reliability were included in the full sample. Where there were coder disagreements on a given variable, the coding decision shared by two of the three coders was used in the final data set.

Although percent agreement may over-estimate reliability by not correcting for chance agreement, we used this statistic here because of the nature of our data. Many of the categories coded in the study were drawn from the theoretical literature pertaining to the ideal knowledge and skills needed for competency with ICT or civic education. Some of these types of knowledge and skills are absent from most or all websites—even in the complete sample of 35 sites. Because statistics like Krippendorff's *alpha*, Scott's *pi,* or Cohen's *kappa* take into account not only the number of categories associated with a given variable, but also the probable frequency of use, when there is little variation in the sample due to the nature of the material being coded, or when all coders are in agreement, these statistics produce low or indeterminate reliabilities.

Because of the small sample size, nonparametric statistics were used to analyze the data when we were exploring differences between groups or relationships between variables.

Results

Uses of ICT

We examined whether the websites varied in their emphasis on fostering cultural, economic, or civic uses of ICT, as measured through the knowledge and skills they taught users. The Friedman Test revealed a significant difference in the emphasis on cultural, economic, or civic uses across the websites on knowledge and skills (see Table 4). For both knowledge and skills, cultural uses were the dominant use of ICT promoted, followed by economic, and then civic uses.

| | ICT Use | | | |
	Cultural	Economic	Civic	
Type of content				Chi-Square
Knowledge	91.4% (32)	77.1% (27)	54.3% (19)	13.58***
Skills	65.7% (23)	37.1% (13)	31.4% (11)	13.05***

Table 4. Comparison of ICT uses on websites

Note. Percentages do not total 100% because each website can have multiple ICT uses. Frequencies are given in parentheses.

*** $p < .001$

Significant differences in the *main focus* of the website followed suit, with cultural uses taking precedence in 19 (54.3%) of the websites and economic uses in 16 (45.7%). None of the sites were coded as mainly fostering civic uses of ICT (Chi-Square(2, N = 35) = 17.87, p < .001). In addition, regardless of what uses of ICT the websites prioritized, more websites offered knowledge (descriptions or links) than fostered skills (instructions or activities).

Ownership and editorial control were related to the main focus of the websites. 76.9% of the for-profit websites focused primarily on cultural uses, compared with 42.9% of the nonprofit websites. 57% of the nonprofit websites focused mainly on economic uses of ICT, compared to 42.9% of the for-profit websites (Chi-Square(1, N = 35) = 3.78, p = .05). Websites where adults shared editorial control with girls or where girls exerted full editorial control were more likely to focus primarily on cultural uses (76.9% did so, compared with 40.9% of the websites in which adults exerted editorial control). In contrast, the majority (59.1%) of the adult-controlled websites mainly emphasized economic uses, whereas only 23.1% of the websites where girls exerted partial or full editorial control did so (Chi-Square(1, N = 35) = 4.27, p = .04).

Occupations

We also examined whether websites included a variety of technical jobs across a continuum of skill levels, coding for the presence or absence of 10 different occupational categories across the websites (see Table 5). Analysis using the Friedman Test showed that the frequency of jobs varied significantly. Higher-skilled jobs were most heavily represented. Occupations represented on fewer than half of websites were the lowest-skilled: technician/operator, customer support, and technical writer. Ownership type had

little impact on the occupations featured on a site. Only one significant difference emerged: 84.6% of the for-profit organizations' websites included reference to careers involving sales, marketing or PR, compared with 47.6% of the non-profit organizations' sites (Chi-Square(1, N = 35) = 4.65 p = .03). Editorial control of the websites was not significantly related to the types of careers mentioned.

Occupation	Percent of Sites
Executive/Officer/Founder/ President/Vice-President/Director	82.9
Researcher/Professor	80.0
Graphic designer/Web designer/Animator/ Writer/Game developer/Composer	77.1
Manager/Leader/Webmaster	71.4
Administrator/Analyst/Engineer	71.4
Sales/Marketing/Public relations/ Community relations	62.9
Programmer	51.4
Technician/Operator	42.9
Customer support/Computer support	11.4
Technical writer	8.6

Table 5. Frequency of occupations on websites
Note. Chi-Square (9, N=35) = 121.04, $p < .001$

ICT Knowledge and Skills

Table 6 presents data on the presence of the major types of ICT knowledge and skills found on the websites. Because a different number of items comprised the indexes for each set of knowledge and skills (communication, social/ethical, and so on; see Table 2 for all items), we computed a ratio based on the summative measure of types of knowledge and skills for each area divided by the number of items in the index. In order to test whether the variables are from the same distribution we used the Friedman Test, which calculates a mean rank for each variable over all the cases and then computes a test statistic that approximates a Chi-Square distribution. Comparison of these ratios revealed a significant difference in the categories of knowledge and skill that were found most often across the websites. The mean rankings from each variable reveal a two-tier emphasis of knowledge and skills: A top tier that included most sites in the sample consisted of communication, social/ethical and technical knowledge and skills, while a second tier was comprised of civic, productivity/multimedia, and research. Neither ownership type nor editorial control by girls or adults bore a relationship with the comprehensiveness of knowledge and skills cultivated on the websites.

ICT Knowledge and Skills	Rank
Communication	4.39
Social/Ethical	4.06
Technical	3.79
Civic	3.29
Productivity/Multimedia	3.10
Research	2.39

Table 6. Mean ranks of ICT knowledge and skills
Note. Chi-Square (5, N=35) = 31.39, *p* < .001

To understand the extent to which websites are emphasizing different ICT knowledge and skills, we computed indexes for each type of knowledge and skills. As Table 7 reveals, the average website includes relatively little attention to each of the categories identified in the literature as required for ICT literacy. For example, the average website included only two references to communication knowledge (out of a possible nine items in the index). Attention to skill areas in communication was even lower—the mean was 1.51. This pattern was consistent across all six areas of ICT knowledge and skills. The low mean scores in all categories indicate that the websites as a group are not teaching a comprehensive range of knowledge and skills. In addition, mean scores show that websites were more likely to teach knowledge than skills in every category.

	Mean	*SD*	Items in Scale
Communication			
Knowledge	2.00	1.73	9
Skills	1.51	1.59	9
Social/Ethical			
Knowledge	1.20	1.05	5
Skills	.77	1.09	5
Technical			
Knowledge	1.71	1.76	7
Skills	1.00	1.37	7
Productivity/Multimedia			
Knowledge	.91	1.09	5
Skills	.43	.74	5
Civic			
Knowledge	1.37	1.59	8
Skills	.57	1.04	8
Research			
Knowledge	.11	.32	1
Skills	.11	.32	1

Table 7. ICT knowledge and skills

Table 8 gives a breakdown of each of the knowledge and skills measured across the websites, allowing us to see what the websites are emphasizing to girls. As noted earlier, communication knowledge and skills appeared on the most websites, led by items such as online games and message boards. Less attention was paid to polls, email, listservs, and chat rooms. Newer communication technologies were rarely referenced, including virtual reality, instant messaging, and text messaging.

	Percent of Sites (n) Featuring Knowledge	Percent of Sites (n) Featuring Skills
Technical		
Hardware		
Definitions	31.4 (11)	8.6 (3)
How to Use	14.3 (5)	8.6 (3)
How to Design	2.9 (1)	0
Software		
Definitions	51.4 (18)	31.4 (11)
How to Use	25.7 (9)	20 (7)
How to Design	34.3 (12)	22.9 (8)
Tinkering and Troubleshooting	11.4 (4)	8.6 (3)

Social and Ethical		
Collaboration/Cooperation	60 (21)	31.4 (11)
Civility	25.7 (9)	20 (7)
Privacy	22.9 (8)	20 (7)
Intellectual Property	5.7 (2)	0
Intellectual Honesty	5.7 (2)	5.7 (2)
Productivity/Multimedia		
Graphics, Art, Presentation	22.9 (8)	8.6 (3)
Web Authoring	40 (14)	20 (7)
Digital Photography	22.9 (8)	11.4 (4)
Spreadsheets	0	0
Word Processing	5.7 (2)	2.9 (1)
Communication		
Email account	20 (7)	20 (7)
Listservs	20 (7)	8.6 (3)
Chat Room	20 (7)	17.1 (6)
Message Board/Bulletin Board	45.7 (16)	42.9 (15)
Instant Messaging	5.7 (2)	2.9 (1)
Text Messaging	2.9 (1)	0
Online Interactive Game	54.3 (19)	34.3 (12)
Virtual Reality	8.6 (3)	2.9 (1)
Polls	22.9 (8)	22.9 (8)
Research	11.4 (4)	11.4 (4)
Civic		
Problem Solving/Decision-making	42.9 (15)	14.3 (5)
Collaborative Learning	22.9 (8)	5.7 (2)
Project-based Learning	11.4 (4)	2.9 (1)
Simulations	0	0
Opinion Expression	17.1 (6)	8.6 (3)
Deliberation	8.6 (3)	8.6 (3)
Participation	25.7 (9)	14.3 (5)
Regulation/policy	8.6 (3)	2.9 (1)

Table 8. Frequency of ICT knowledge and skills on websites

The websites in the sample also devoted some attention to social and ethical knowledge and skills, led by collaboration/cooperation. Fewer websites addressed civility and privacy, and almost none dealt with intellectual honesty or intellectual property.

The technical knowledge and skills addressed most often on the websites tended to focus on software, such as defining software terms, designing software, and using software applications. By contrast, fewer websites focused on defining hardware terms, how to use hardware, or tinkering and troubleshooting hardware. Almost no websites targeted at girls covered anything having to do with designing hardware.

Productivity and multimedia knowledge and skills were led by web authoring, with somewhat less focus on digital photography and graphics and art. Only a handful of the websites addressed word processing, and none addressed spreadsheets.

The websites scored lowest on teaching civic and research knowledge and skills. Civic knowledge and skills taught by the sites consisted mostly of civic problem-solving or decision-making. Fewer websites fostered users' abilities to participate in civic life, collaborative learning on civic issues, opinion expression, or civic project-based learning. The websites mostly ignored deliberation and ICT regulation and policy, and no website addressed civic simulations. Research knowledge and skills were also neglected by most of the websites.

Qualitative Analysis

Qualitative analysis helps explain why some websites did teach a more comprehensive range of knowledge and skills. Examination of the highest-scoring websites across the spectrum of knowledge and skills revealed that these websites were general interest communities that covered a wide range of topics. By contrast, websites focused exclusively on boosting girls' interest in science and technology did not pay much attention to cultivating a breadth of skills and knowledge. Ownership did not appear to influence comprehensiveness of knowledge and skills taught, as websites that scored best overall were a mix of commercial and noncommercial sites. However, editorial control did seem to play a role, as most of the top websites allowed adults and girls to share control by permitting girls to submit articles and message board postings extensively.

Purple Pyjamas offers an example of one of the most comprehensive websites. Run by a nonprofit organization (yet also supported by Google advertisements from national retailers), the website is an online community with main menu links to advice, entertainment, fun, creativity, humor, life, and opinion. The website's distinguishing feature is that it tries to maximize girls' contributions of writing and images on every page. Even the rotating images in the upper left corner of the homepage are of girls who use the website. Purple Pyjamas cultivates technical and productivity-multimedia knowledge and skills mainly through its Tech Nerd column and Help Desk, which answer questions about computer use submitted by website users. This example question reveals a typical concern of website users and the level of technical sophistication of their queries:

> I have been getting harassed on the internet on my blog. I track IPs, but
> have no way to read them/tell me who they are from. Know of any good
> sites that tell me where they come from, and can they tell me who the IP
> belongs to? Like their name, address, daytime telephone number? Your
> help would be greatly appreciated.
>   -Christine, 19 from United States

The website also fosters girls' communication knowledge and skills through its chat room and highly active message boards. Purple Pyjamas provokes civic discussion in the many

political topics found in its Debate Forum message boards, and via a "Hit Me" page edited by a 20-year-old who poses questions on controversial issues and solicits short essays from readers. The Debate Forum also raises social and ethical issues, for example through discussions about appropriate age limits on using instant messenger software, privacy, and security.

We found gURL.com to be the best example of a website that fostered civic knowledge and skills, given that most websites did not do much in this regard. A general interest community and e-zine for teen girls, gURL.com is for-profit and advertiser-supported. Although advice, relationships, games, and fashion are more prominent on the main menus on the website's homepage, civic content is woven lightly throughout. The website's widely-used "Shout-out boards" (message boards) allow girls to initiate and discuss a broad range of topics, including censorship and free speech. Another main menu item from the homepage encourages girls to "React" by taking part in polls and opportunities to debate politics and media ethics, sparked by provocative questions from the website's editors. For example, during the 2004 presidential campaign, the site posed the following query to readers:

> Is "voting for old people"? (a t-shirt from Urban Outfitters). Urban Outfitters' new t-shirt campaign has stirred up controversy in what is shaping up to be a heated election year. While some critics say the t-shirt is "the wrong statement at the wrong time," Urban Outfitters claims the shirt speaks the truth about young people being jaded by (and left out of) the political process. What do you think? Does all of the politicians' talk of Social Security and prescription drug benefits for the elderly, tit-for-tat sound-byting, and their seemingly obligatory blow-dried hairdos turn young folk off from voting? If you could vote, would you?

The question garnered 285 responses from the site's users, including some long and thoughtful arguments for and against voting that raised questions about the fairness and inclusiveness of the political system, the efficacy of individual voters, and politicians' lack of attention to issues of importance to youth.

Discussion

Uses

The data gathered here indicate that websites designed to engage girls with ICTs attempt to do so by emphasizing the technology's cultural and economic uses. For-profit and girl-created websites were more likely to focus mainly on teaching about cultural uses of ICTs. Non-profit and adult-created websites were more likely to focus primarily on teaching about economic uses. The absence of any websites that mainly emphasize civic uses of technology is especially notable, in that coders recorded the presence anywhere on the website of such content, and used a broader definition of civic activity than is commonly found in the literature on political socialization.

Several factors may explain the small amount of attention paid to the civic aspects of technology in this sample. Ensuring that females can use ICTs to participate equally in public life is a less common rationale for closing the gender gap in computing in the literature. This may reflect that American public culture tends to be more individualistic and market-driven than collective or civic in nature. In addition, the economics of commercial sites likely militate against a civic focus, as it would be less likely to attract an audience of teen girls to deliver to advertisers. Many of the non-profit sites depend on grant money from the National Science Foundation and private foundations associated with the ICT industries, which tend to frame the problem of the gender gap as an economic one.

Although the economic, cultural, and civic uses of ICTs all deserve to be represented on websites designed to engage girls with technology, it can be argued that the civic rationale especially deserves attention for several reasons. First, although only a fraction of all girls (and of all boys for that matter) will be needed to work in ICT industries, all girls will become citizens. Second, civic life increasingly requires the use of ICTs in order to engage with politics, government, and civil society (Cornfield, 2004); those who are not comfortable engaging with public life online will be disadvantaged. Third, ICTs raise new policy and ethical issues (such as music file sharing) that especially affect youth's interests and opportunities. Fourth, the crisis of civic engagement by youth (Delli Carpini, 2000; Putnam, 2000) requires new means to reconnect young people with public life; some have suggested that new media could be an effective means for doing this (Montgomery et al., 2004).

Viewed in this light, the websites in this sample appear to have missed an opportunity to engage girls with ICTs via civic issues (such as the ethics of designing ICTs to balance privacy and security concerns). The websites also have missed an opportunity to include ICT knowledge and skills in girls' civic toolkits. For example, just 17.1% of the websites fostered some knowledge of how to express one's opinion on civic issues (through petitions, polls, letters to the editor, article submissions, and so on). Political communication research shows American women are still significantly less likely than men to participate in politics by contacting a public official, discussing politics with friends and family, or trying to influence others' votes (Atkeson & Rapoport, 2003).

Occupations

The websites for girls coded in this study were more likely to feature professional and managerial ICT occupations. Therefore, these websites generally succeeded at reversing the stereotypes found in ICT advertising that depicted women as lesser-skilled users of technology. The websites provided girls with numerous role models who were shown as expert designers, managers, and users of ICTs.

Yet the emphasis on elite occupations means that there was little representation of lower-status technical jobs that may be reasonable for some girls to consider. Some of these jobs, such as technical writing and some kinds of technicians, have also not been traditionally identified with females. Prior research on mass media has often found an

absence of positive working-class role models and occupations (Holtzman, 2004). Social learning theory suggests that realistic role models are the most powerful for media users, who are more likely to imitate a modeled behavior if they perceive the model as similar to themselves and the model's behavior is portrayed as valuable (Bandura, 1977). This suggests that websites that show only elite occupations run the risk of generating a negative self-concept in some users who do not feel that they can meet the high standards set by role models on the website. An absence of women role models depicted as engaged in dignified yet lower-status ICT work may deter some girls from entering the field.

Knowledge and Skills

As a group, the websites put more emphasis on knowledge than skills, often failing to provide girls with opportunities to develop their skills at using common online features. For example, 42.9% of websites offered instructions or activities having to do with message boards, 34.3% with games (mostly single-player rather than interactive, multi-player games), and 22.9% with polls; even fewer sites cultivated skills in using chat rooms (17.1%), listservs (8.6%), or simulations (0.0%) (see Table 8). Note that we coded websites as developing skills with these features even if they did not include the feature on the website itself, but merely offered an activity (such as a quiz) that allowed girls to polish their skills in using an interactive feature. The inattention to skills development may be attributable to cost and liability: Maintaining many kinds of high quality interactive content typically requires greater staff time, and irresponsible use of some interactive features (such as chat rooms and message boards) may render websites liable for policing sexual harassment, defamation, invasion of privacy, and so forth. Further research is warranted into why these websites are not making greater use of interactivity, which is one of the Web's defining features.

In addition, the websites scored surprisingly low on the indexes of knowledge and skills that are considered necessary for ICT literacy. Despite the fact that a single sentence offering basic information about one of our categories anywhere on a website would have led us to code the entire website as fostering knowledge, and a brief set of instructions would have qualified the entire website as teaching skills, few websites offered a comprehensive range of ICT knowledge and skills. Even the mean for technical knowledge was disappointingly small, given the stated mission of the websites to engage girls with ICTs, often including spurring girls to consider careers in the field. These findings suggest that by focusing most often on fostering communication abilities, the sites are emphasizing what girls already know and do best on the Web. Also worth noting was the low level of civic content, including attention to social, ethical, and policy issues raised by ICTs themselves—a missed opportunity to engage girls with larger ethical and policy concerns that are relevant to their own use of the technology. Follow-up qualitative analysis of the websites indicated that even when civic material was present, it made up a small proportion of the websites, which were mainly devoted to relationships, health, fashion, popular culture, and shopping. Furthermore, there was little crossover between ICT and civic content on these websites. More often, sections of websites devoted to boosting ICT skills were separate from areas devoted to politics or community service. The most frequent area of crossover was media literacy issues, which often

focused on critiquing female body images in the media or the stereotype that girls cannot be feminine and interested in science and math at same time. Yet we found little attention to the specifics of ICT policy in these sections.

Conclusions

This study is the first systematic examination of how websites designed to involve girls with technical learning and careers represent ICTs. These websites represent one of many strategies aimed at closing the gender gap in computing, along with changing classroom pedagogy in technical courses to emphasize practical applications, reversing family dynamics that favor boys' computer use over girls', transforming the time-intensive and masculine workplace culture of the technology industry, challenging mainstream media stereotyping of computers as a male domain, and creating suitable computer games for girls (American Association of University Women, 2000).

Although a content study cannot determine what users are learning from these websites, this research raises questions about whether the websites in this sample can fulfill their purpose of involving girls with ICT, given the websites' current design. Although the websites are challenging mainstream media stereotypes of women as less technically competent with images of women role models in elite ICT jobs, the lack of lower level ICT role models may deter some girls from entering the field. Perhaps because of costs and legal concerns, most of these websites are not taking full advantage of the Web's interactivity to offer skill-building instructions and activities online, instead offering up static content that is less likely to engage girls over time. As a group, the websites are not fostering the comprehensive range of skills and knowledge that girls need to be literate with ICTs. Content emphasizing proficiency with using ICTs for civic purposes is especially notably absent, and the websites pay little attention to social, ethical, or regulatory issues raised by ICTs themselves. In some ways, these websites appear to be devoted to teaching girls what they already know. Many websites, especially those run by commercial organizations, emphasize the cultural uses of ICTs, areas where girls have apparently reached parity with boys. All of the websites focused most on developing girls' communication knowledge and skills, which prior research indicates are already quite strong. The scant technical information on the websites is more about software than hardware.

Content analysis of websites is an emerging methodology. Although our sample reflects our best efforts to include a comprehensive list of U.S.-based websites that attempt to engage girls with ICT, given the impossibility of locating a universe of websites using current search tools, we can only generalize our findings to the 35 websites examined here. Additionally, the large size of many websites presents the possibility of coders missing some content as they navigate through many pages. However, our intercoder reliability results offer some reassurance, as does our qualitative analysis, which yielded converging support for the quantitative results of the content analysis. Our coding for the presence or absence of a given content attribute anywhere on a website is another limitation of the study, but one that does not undermine its major findings. Our coding scheme did not distinguish between websites that featured an attribute prominently or

extensively and those that treated it marginally or briefly. Future studies could do so by constructing measures of prominence (such as weighting content based on the number of links away from the homepage where the content is located) and extensiveness (such as the number of words, links, images, audio, and video files devoted to a topic). The major findings in this study would not be affected by using such metrics, however. The fact that the websites scored poorly on many measures even though a single mention of an ICT skill or civic use of ICT would have been enough for us to code the website as including them indicates that the bias of our research instrument was toward *overestimating* rather than underestimating the frequency of the kinds of content found to be missing on so many websites. This being the case, a more fine-grained analysis should not challenge our findings.

We propose that it is time to rethink the gender gap and the rationale for closing it to include the civic uses of ICTs and the policy issues raised by them. This would involve designing websites that address girls more as emerging information age citizens than as present consumers or future employees. It may be most important for websites to encourage girls to participate in democratic processes of designing, implementing, and regulating what Lessig (1999) has called "code." By "code" Lessig means both the design of computer architecture (software, hardware, and systems) and relevant codes of law, policy, and ethics. In this view, girls need hands-on experience writing both kinds of code. This study suggests some elements that website designers can build upon to create more civic, comprehensive sites for girls. Websites appear to be most likely to feature content aimed at fostering girls' comprehensive and civic ICT knowledge and skills when designers share editorial control with girls and when designers minimize the profit motive while assuring a funding stream to support the website. As a nonprofit that features some less intrusive Google ads, Purple Pyjamas strikes an interesting balance. In addition, it would be advantageous for nonprofit organizations to pool their resources to develop more sophisticated websites that include features and activities that allow girls to build their skills, rather than posting "brochureware" websites that simply describe the sponsoring organization's offline activities with girls.

This study suggests several directions for future research. Further work would be helpful on the economic forces shaping website design and maintenance. Interviews with website designers could help identify barriers to more comprehensive and civic content, and spark thinking about new funding and content development models that would better support girls' ability to see themselves as empowered by the full range of ICT knowledge and skills in the information age. Comparing websites aimed at engaging girls with ICT with those designed for all youth is also important for assessing the value of gender-specific sites. It is likely that girls visit gender-neutral websites more often than they visit most of the websites in this sample. News websites, community websites, and the many websites designed to engage young people in voting, volunteering, and other civic activities may offer a broader range of ICT skills and knowledge as well as more civic content.

The optimal research strategy may be to learn from girls themselves about how and where they develop their ICT abilities, especially for civic uses of technology, in the online world. This research could include both user studies and content studies of how

girls interact with websites created by institutions (through message boards and other online submissions) and personal websites created by girls themselves. For example, some of the most sophisticated learning about web design by girls appears to be happening on "graphic" and "blend" sites, which girls create to display their technical and artistic abilities with graphics programs, poetry, and blogging (Polak, forthcoming). Although these websites were not included in our sample because they are personal websites, they often comprise informal learning communities by joining in webrings that promote design competitions, tutorials, and trading feedback on design and technical issues. Some fine work has been done on how these websites provide spaces for girls to explore their identities (see also Mazzarella, 2005; Stern, 2002; Stern, 2004). The next step is to examine how girls' own contributions to cyberspace can inform how websites might boost girls' civic engagement with ICTs. Such research could suggest new ways to exploit the communicative lure of new media for girls to foster gender equity among those who will shape the future of these media, not simply as employees or consumers, but as citizens.

Acknowledgments

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