Computers have become an important part of young children's lives (Clements, 1998), both as a source of entertainment and education. The National Association for the Education of Young Children's (NAEYC) position statement on Technology and Young Children (2006) supports the need for equal access to technology for all children with attention to eliminating gender stereotypes.

Some educators have observed that computers may have created gender inequities in access to and use of technology (Hartzel, 2003; McNair, Kirova-Petrova, & Bhargava, 2001, Nelson & Watson, 1991; Sutton, 1991). Studies indicate that gender differences in young children's access and use of computers may be the outcome of environmental factors (Kalyanpur & Kirmani, 2005; Volman & Eck, 2001). These are among the findings:

- Boys from their early years are typically afforded more computing opportunities than girls.
- Families with young males are more likely to own a home computer.
- Boys are three times more likely than girls to attend summer computer camp.
- Teachers favor boys compared to girls in computer classes.

To successfully avoid this apparent gender-related digital divide, it is important to address gender inequities with computer use beginning in early childhood.

This article looks at two major environmental influences—children's social orientation and the role of media and instructional materials—that contribute to these gender differences. It also analyses two outcomes of these environmental influences: differences in use of computers for work and play and in social interactions in and around computers. The article concludes by presenting some strategies that can help reduce gender bias through appropriate attention to learning styles, role modeling, selection of software and online activities, and gender-conscious classroom practices.

Environmental Factors That Contribute to Gender Differences

Several factors influence how children respond to technology. Children's social orientation (their exposure to gender-specific roles, expectations, and attitudes), and the role of media and educational materials, both affect young children's access and use of computers.

Mubina Hassanali Kirmani, Marcia H. Davis, and Maya Kalyanpur

Mubina Hassanali Kirmani, Ed.D, is a Professor in the Department of Early Childhood Education, Towson University, Towson, Maryland. She worked as researcher in the Media Lab at Massachusetts Institute of Technology and has taught courses on computers and young children. She has published several articles related to gender inequities and technology.

Marcia H. Davis, Ph.D., is an Associate Research Scientist, Talent Development High Schools for the Center for Social Organization of Schools at Johns Hopkins University, Baltimore, Maryland.

Maya Kalyanpur, Ph.D., is Technical Advisor to the Special Education Office of the Ministry of Education, Cambodia. She is formerly a Professor in the Department of Special Education, Towson University, Towson, Maryland. Her research has focused on the intersection of culture and disability, with specific reference to culturally diverse families and international special education policy. She has published extensively.
Social Orientation

Gender differences are evident from an early age. Gender-specific roles, as defined by societal norms, are exhibited in the behaviors and activities of young children (Fagot, Leinbach, & Boyle, 1994; Kirmani & Davis, 2000; McNair, Kirova-Petrova, & Bhargava, 2001; Pitcher & Schultz, 1983; Weinraub et al., 1984). Differences in adult attitudes toward males and females give cues to children about gender-specific roles and stereotypes. In many cultures, males are expected to be active and tough while girls are expected to be pretty and delicate.

The types of toys and play activities children are exposed to further help to embed gender-specific choices. Ramsey (2004) notes that toy and clothing retailers typically have “pink” aisles filled with dolls, fashion kits, glittery paints, and pink and purple outfits targeted toward females. Other “grayish-brown” aisles display action figures, construction kits, vehicles, war toys, and guns targeted at males.

As Maccoby (2000) points out, children’s early social orientation is often reflected in educators’ and families’ approaches to and use of technology. Sutton (1991) found that male children are introduced to computer technology earlier and more frequently at home than females, and that females more often report being introduced to computer technology for the first time in schools.

Similarly, in many early childhood classrooms, females mainly occupy the housekeeping area, cooking and playing a nurturing role, while males typically play and construct with blocks or drive trucks and tractors at the sand table. Outdoor play may also reflect gender stereotypes, with females preferring to swing or engage in interactive play while males choose riding vehicles and chasing games.

Role of Media and Educational Materials

Entertainment and education environments socialize children into gender stereotypes. Highly feminized or masculinized characters are common in movies, television, computer games, toys, and clothing. In consumer items and commercial advertising, gender-specific roles are maintained and emphasized, with males more often portrayed in active, professional roles and females as sex symbols (Dill & Thill, 2007; McNair, Kirova-Petrova, & Bhargava, 2001). In some promotional materials for education, boys were presented as competent users, while girls were more often included merely for “decoration” (Knupfer, 1998, p. 55).

A study of female main characters in software found that, out of 41.7% of characters with clearly identifiable gender attributes, only 12.5% were female (Hodes, 1995).
A similar study by Sheldon (2004) focusing on preschool software found significantly more male than female main characters. In game-oriented learning software, females often remain in the background, playing secondary roles, while males are in dominant positions, controlling the outcome of the play (Canada & Brusca, 1992; Dill & Thill, 2007).

- Women are portrayed as helpless beings, as in the Nintendo game “Mario Brothers,” where the main characters Mario and Luigi, try to rescue the princess.
- In “Mousecapades,” Minnie Mouse plays a minor role and passively follows Mickey Mouse, who leads the combat and wins points.

Most software is structured for competition.

Early studies found that even when software programs used somewhat gender-neutral characters, children, particularly males, tended to assign masculine attributes to them (Bradshaw, Clegg, & Trayhurn, 1995). Most software, including instructional software, is still often structured for high levels of competition, driving winners to reach the next level of accomplishment by providing macho-oriented rewards such as fiery explosions and blasting sounds. Even when females are lead heroines, they are displayed in highly sexualized ways, “as objects for heterosexual male consumers” (Gorski, 2005, p. 37).

Learning materials may provide similar social cues. Textbooks and story books further condition children to accept stereotypical gender roles by presenting women in more menial roles, such as secretaries or medical assistants, while men are pictured in managerial and decision-making positions (Agars, 2004; Knupfer, 1998). Essentially, the kinds of learning experiences females are exposed to through media or instructional materials tends to discourage girls from wanting to spend more time on computers and taking ownership of technology, or even choosing computer-based careers.

Differences in Computer Use for Work and Play

Males and females differ with regard to their social attitudes, behaviors, and choice of information and activities when using computers.

- Women use computers to e-mail and maintain relationships, shop, do online-dating, and seek information on health and to how to become more nurturing as parents. In contrast, men use computers for career enhancement, to keep in touch with colleagues and scientific-networking, and for competitive sports (Menard-Warwick, Dabach, & Blanca, 2002).
- Similarly, women were found to use computers as a tool to create and maintain relationships via e-mail more than men do (Boneva, Kraut, & Frohlich, 2001).
- Women use computers to accomplish tasks with word processing, graphic design programs, and communication tools, while men use computers as toys for playing, programming, or exploring hardware systems (Raphael, 2002).
Similar to adults, children also view and respond to computers differently by gender. The familiarity of males with interactive gadgets in play often leads them to approach computers as toys. They like to explore, tinker, construct, and experiment with computers, whereas females’ limited exposure to technology often results in them using computers more as a tool to complete tasks. Again, males’ preferences for game-like competitive approaches of moving up from one level to another makes them take a more linear path in their exploration of computers, whereas females prefer to create products, such as stories through multiple paths that use text, pictures, and/or symbols.

Studies that examine what children paid attention to when working at the computer show marked differences in how they express and share information (Boneva, Kraut, & Frohlich, 2001; Hanor, 1998; Kirmani & Davis, 2000). In Kirmani and Davis’ study (see Figure 1), young males used text mainly to share knowledge about their interests and hobbies while females used designs and drawings to express relationships and emotions. Females also paid more attention to decorative details on the screen.

Similarly, Hanor’s preschool study (1998) found that girls more frequently valued choices within art or graphics application programs that allowed use of color, shapes, symbols, clip art, and animated sequences to share their stories or express knowledge.

Children also vary by gender in the types of information they seek on the Internet. Kirmani & Davis (2000) found that females sought artwork, stories, Beanie Babies®, and Barbie® dolls. They were drawn to programs that offered nurturing activities such as fashioning and feeding dolls, or that facilitated the production of colorful graphics and drawings. Males, on the other hand, gravitated to information on sports, wild animals, and action games, and sought activities that involved exploring, constructing, and destroying in fast-paced violent activities.

**Social Interactions Around Computers**

Males and females appear to gravitate to computers with different styles.

- When a computer was available, males were more likely to approach it than females, especially on initially entering the room, and were more assertive in order to access it (Bray, Brown, & Green, 2004).

- A computer-mediated study on the social interactions of 7- and 9-year-olds working in same or mixed-gender pairs showed that, at both ages, mixed-gender pairs showed more assertive and less collaborative interaction than same-gender pairs (Fitzpatrick & Hardman, 2000).

**Figure 1.** Young males used text mainly to share knowledge about their interests and hobbies while females used designs and drawings to express relationships and emotions (Kirmani & Davis, 2000).
Females complained about being put down at the computer by their male classmates. On the other hand, females were more likely to use a computer if it was available for longer periods of time (Green, 2003).

In other words, in the presence of male classmates, females may have fewer opportunities to access and use computers.

Peer interactions are key to females’ learning and productivity with the computer as an enabling device.

• Females enjoyed using computers if they could interact, not just with the machines, but also with their peers (Raphael, 2002). One game was described as being “not that funny” if played alone (Hanor, 1998, p. 66).

Female interpersonal sharing at the computer often resulted in the creation of shared products and new knowledge (Hanor, 1998).

• Males, on the other hand, enjoyed playing alone, especially games with virtual characters, and liked to compete with the computer, attempting to beat it at its own game (Hanor, 1998).

In summary, there are marked gender differences in access to hardware and software, social behaviors, work and play styles, and choices of information and activities. These differences underscore the need for families and teachers to create a gender-responsive computer environment for both males and females to optimize their enjoyment and learning.

Strategies to Reduce Gender Bias

Three strategies that can help reduce computer-use gender bias—creating opportunities for gender-sensitive learning styles, providing real and virtual female role models, and selecting appropriate software and online activities for classrooms—are discussed here.

Recognize Gender-Sensitive Learning Styles

A collaborative style of learning has been shown to be important for females. Providing learning environments where they can work together increases their motivation to use computers. Females also benefit if they are given more time at the computer to experiment with pictures and sounds, create stories, or express and share ideas, all of which are seen as making computers more fun.

Create gender-sensitive learning opportunities.

Further, in order to facilitate more efficient outcomes for females, encourage them to work in single-gender pairs or small groups. This gives them opportunities to take turns and play more primary roles at the computers. Consequently, the strategy helps build their self-esteem related to technology use.

Females have different interests than males and like to work in environments that are aesthetically appealing. In line with a contemporary constructivist approach, technology can also be learned and applied in ways that are appealing to females.
If the machines are colorful, females may be more attracted to them and more likely to engage in the hands-on experience of pulling apart or restructuring hardware parts, thus demystifying the technology. Females appreciate opportunities to select and use blocks, creative tools, patterned icons, or designs to create, construct, and experiment with as they acquire important concepts in math, science, and in other subjects.

Enhance Female Role Models
The Web can be used to identify female leaders in many professions for both children and adults. Through pictures, sounds, and stories, young children can view powerful women from the past and present. With adult supervision, they might even communicate with some, such as authors of children’s books, through visual and audio devices or in guided chat rooms.

Select appropriate software and online activities.

Select Suitable Software and Online Activities
The Cyber environment, including game software and instructional online activities, is often designed by males in ways that tend to exclude females from the main computer culture (Gorski, 2005). Several approaches have been developed in response to the issue of designing multimedia games for girls (Raphael, 2002).

- Often referred to as “Game Girls” strategy, the first approach was informed by feminist theory (e.g. Gilligan, 1982). Activities appealed to “gender-traditional” female social and sensory interests, such as collaboration, glamour, and bright colors.
- The second approach, the “Game Grrls” strategy, provided females with opportunities to participate on an equal footing with males, encouraging them to become assertive “feminine warriors” as a means of empowering them to beat males at their own games (Wilding, 2001).
- The third approach tried to seek a middle ground by identifying interests common to both females and males, such as mystery games and puzzles, and using animals as gender-neutral primary characters. This approach offered open-ended alternatives that enabled participants to create their own virtual reality by choosing characters and non-linear pathways to reach a solution or win the game.
- The fourth and most recent approach, suggested by Raphael (2002), addresses the broader problem of female under-representation in management of information technology projects and other leadership positions, and argues the need to involve more females in the design of software. Raphael recommends launching young females into this pathway by exposing them to non-stereotypical images of women in technological fields. Also, in order to design software, somewhat older female students would be introduced to programming in a non-linear way. After an introduction to basic programming codes, they would be allowed to continue through multiple paths, possibly with the use of sounds, colors, and shapes. This way, females can advance in use of technology within learning contexts that are more

Provide real and virtual female role models.

Although gender stereotypes can be reduced by presenting images of women working in all kinds of fields using technology, the problem of showing competent female computer teachers may still remain (Shade & Davis, 1997). Most preschool and elementary teachers are females and can be important role models for younger generations. However, many female teachers may still have less confident attitudes about computers.

Educators and female family members can benefit from more incentives and time to become more comfortable in integrating technology in their teaching, volunteer efforts, and play at home. Teachers are urged to invite women who are computer technicians and engineers to demonstrate their ease with computers to children in classrooms. When adults consistently call upon females to troubleshoot computer issues, they convey the message to children that “computer knowledge is not just for boys” (McNair, Kirova-Petrova, & Bhargava, 2001, p. 53).
appealing to them and become motivated to pursue computer-related professions.

In conclusion, gender bias in computer access and use can begin at an early age. In order to ensure equity, it is important to provide a secure, comfortable, non-hostile technology environment for young children (Gorski, 2005). A combination of several strategies that includes addressing gender-sensitive learning styles, providing appropriate role modeling, designing bias-free software and online activities, and implementing appropriate teaching strategies with computers can help to promote meaningful computer learning among all young children.

References
Put These Ideas Into Practice!

Young Children Surfing:
Gender Differences in Computer Use

Mubina Hassanali Kirmani, Marcia H. Davis, and Maya Kalyanpur

Strategies to minimize gender bias in computer use at home and in early childhood programs

Plan the learning environment
✓ Locate computers for convenient, equitable access and easy monitoring by an adult.
✓ Supervise computer sign-up lists and volunteers to ensure that females and males have equal opportunities to participate.
✓ Arrange some single-gender grouping to give females opportunities to take primary roles.
✓ Set aside longer blocks of time for females to allow social interactions at the computer and facilitate completion of tasks.

Make wise software choices
✓ Select programs that depict people in non-stereotypical activities and occupations.
✓ Choose music and games that use both male and female voices.
✓ Supply software that is open-ended and offers choices.

Encourage adults and children to explore how computers work
✓ Choose colorful computer hardware to make it more appealing to females.
✓ Organize a variety of activities and topics with use of different electronic and non-electronic materials to permit choices for all children.
✓ Encourage hands-on experience to play with the insides of safe, recycled computers to increase familiarity with technology.

Promote computer career awareness
✓ Ask females to help with computer problems as often as males.
✓ Delegate responsibilities by asking females to serve as peer computer helpers.
✓ Ask older females to serve as competent role models for children learning how to use computers.
✓ Encourage females to become their own advocates.
✓ Offer computer classes for teachers and families, including classroom volunteers.
✓ Invite female computer technicians, engineers, and architects to demonstrate computers with children and build awareness of innovative technologies.