



EXECUTIVE SUMMARY

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In contemporary culture, the computer is no longer an isolated machine: It is a centerpiece of science, the arts, media, industry, commerce, and civic life. Information technology is transforming every field, and few citizens are unaffected by it. The commission has chosen to use the terms “computers” and “computer technology” to refer to this larger “e-culture” of information and simulation, and has focused its inquiries, discussion, and recommendations on computers and education.

The question is no longer whether computers will be in the classroom, but how computers can be used to enhance teaching and learning—ideally, in ways that promote the full involvement by girls and other groups currently underrepresented in many computer-related endeavors. The commission’s themes and recommendations, while focused on girls in schools, would, if addressed, improve the quality of the computer culture for all students.

Key Themes

1. Girls have reservations about the computer culture—and with good reason. In its inquiries into gender issues in computers and education, the commission found that girls are concerned about the passivity of their interactions with the computer as a “tool”; they reject the violence, redundancy, and tedium of computer games; and they dislike narrowly and technically focused programming classes. Too often, these concerns are dismissed as symptoms of anxiety or incompetence that will diminish once girls “catch up” with the technology.

The commission sees it differently: In some important ways, the computer culture would do well to catch up with the girls. In other words, girls are pointing to important deficits in the technology and the culture in which it is embedded that need to be integrated into our general thinking about computers and education. Indeed, girls’ critiques resonate with the concerns of a much larger population of reticent users. The commission believes that girls’ legitimate concerns should focus our attention on changing the software, the way computer science is taught, and the goals we have for using computer technology.

2. Teachers in grades K-12 have concerns—and with good reason. Teachers, three-fourths of whom are women, critique the quality of educational software; the “disconnect” between the worlds of the curriculum, classroom needs, and school district expectations; and the dearth of adequate professional development and timely technical assistance. Even those teachers technologically savvy enough to respond to the commission’s online survey had incisive criticisms of the ways that computer technology has come into the classroom, and of the ways that they are instructed and encouraged to use it.

Often, teachers’ concerns are met with teacher bashing: “Teachers are not measuring up” to the new technology, is our frequent response. Again, the commission sees it differently. Rather than presume teachers’ inadequacies, the commission believes that teachers need opportunities to design instruction that takes advantage of technology across all disciplines. Computing ought to be infused into the curriculum and subject areas that teachers care about in ways that promote critical thinking and lifelong learning.

3. Statistics on girls' participation in the culture of computing are of increasing concern, from the point of view of education, economics, and culture. Girls are not well-represented in computer laboratories and clubs, and have taken dramatically fewer programming and computer science courses at the high school and postsecondary level. Therefore, girls and women have been labeled as computer-phobic.

The commission sees it differently: It interprets such behavior not as phobia but as a choice that invites a critique of the computing culture. We need a more inclusive computer culture that embraces multiple interests and backgrounds and that reflects the current ubiquity of technology in all aspects of life. As this report describes, girls assert a “we can, but I don't want to” attitude toward computer technology: They insist on their abilities and skills in this area even as they vividly describe their disenchantment with the field, its careers, and social contexts. Although some of this attitude may be defensive, it is important to take a hard look at what these girls are feeling defensive about.

4. Girls' current ways of participating in the computer culture are a cause for concern. A common alternative to computer science courses—and a common point of entry for girls into the computer world—has been courses on computer “tools,” such as databases, page layout programs, graphics, online publishing, and other “productivity software.”

The commission believes that while mastery of these tools may be useful, it is not the same thing as true technological literacy. To be “technologically literate” requires a set of critical skills, concepts, and problem-solving abilities that permit full citizenship in contemporary e-culture. Girls' grasp of specific computer tools—use of the Internet and e-mail, and competency with productivity software such as PowerPoint or page layout programs—may have satisfied an older

standard of computer literacy and equity; the new definition of computer literacy and equity described in this report is a broader one. (See “What Is Fluency with Information Technology?” on page xi.)

The new standard of “fluency” assumes an ability to use abstract reasoning; to apply information technology in sophisticated, innovative ways to solve problems across disciplines and subject areas; to interpret vast amounts of information with analytic skill; to understand basic principles of programming and other computer science fundamentals; and to continually adapt and learn new technologies as they emerge in the future. It is our job as a society to ensure that girls are just as competent as their male peers in meeting these standards.

When they began their deliberations, commissioners explored various ways of defining what it would mean to achieve “gender equity” in the computer culture. Some commissioners emphasized concrete suggestions to get more girls into the “pipeline” to computer-related careers and to participate in these disciplines as they are presently constituted. Other commissioners emphasized ways that the computer culture itself could be positively transformed through the integration of girls' and women's insights, concentrating on the “web” of cultural associations that women's greater participation might create.

The commission does not view the two perspectives as dichotomous or competing. They are mutually reinforcing. One of the values in getting more girls and women in the computer pipeline is that their greater presence may transform the computer culture overall; by the same token, changes in the e-culture itself—the ways technology is discussed, valued, and applied—would invite more girls and women to participate fully in that culture.

What Is Fluency with Information Technology?

What “everyone should know” about technology cannot be a static list of prescriptions to use word processing programs or e-mail. Instead, fluency goals must allow for change, enable adaptability, connect to personal goals, and promote lifelong learning. Like language fluency, information technology fluency should be tailored to individual careers and activities.

As described by a National Research Council report, fluency with information technology* requires the acquisition of three kinds of interdependent knowledge that must be taught in concert: skills, concepts, and capabilities. Skills are necessary for job preparedness, productivity, and other aspects of fluency. They include such things as using the Internet to find information, or setting up a personal computer. Skills change as technology advances: Using the Internet became essential in the past five years, and designing a home page will be essential soon. Concepts explain how and why information technology works. Capabilities, essential for problem solving, include managing complex systems as well as testing solutions.

Fluency is best acquired when students do coherent, ongoing projects to achieve specific goals in subjects that are relevant and interesting to them.

A project for biology students might be: Design an information system to track HIV testing and notification; communicate the design to potential participants; and convince users that privacy will be maintained. In this example, students would need

content knowledge about HIV testing and about notification practices. They would use fluency skills such as organizing a database and communicating with others, and fluency concepts such as algorithmic thinking and an understanding of personal privacy concerns. To complete the project, students would use fluency capabilities such as sustained reasoning, testing solutions, and communicating about information technology.

A project for German language learners might be: Critique a program that translates directions for using a cellular phone by researching alternative cellular phone interfaces; devise tests of the program; evaluate the translation with potential users; and design a presentation to communicate recommendations to program designers. Students would need content knowledge of contemporary German language, such as referring to a cellular phone as a “handy,” as well as appreciation of the diverse cellular phone interfaces. Students would need fluency skills, such as using the Internet to find information and using a graphic or artwork package to create illustrations. They would use fluency concepts, such as algorithmic thinking and awareness of the social impact of information technology. To complete the project, they would use fluency capabilities, such as testing solutions, managing complex systems, and thinking about information technology abstractly.

* The term fluency and its description are adapted from the National Research Council, Computer Science and Telecommunications Board, *Being Fluent with Information Technology* (Washington, DC: National Academy Press, 1999).

The commission has reviewed existing research, considered research that the AAUW Educational Foundation commissioned on the topic, talked with researchers, and listened to girls' and teachers' observations about computing. The commissioners urge immediate action on the following recommendations to ensure social equity as well as a more thoughtful integration of technology in education and our lives.

KEY RECOMMENDATIONS

Compute across the curriculum. Computers can no longer be treated as a “set aside,” lab-based activity. Computation should be integrated across the curriculum, into such subject areas and disciplines as art, music, and literature, as well as engineering and science. This integration supports better learning for all, while it invites more girls into technology through a range of subjects that already interest them.

Redefine computer literacy. Computer literacy needs to be redefined to include the lifelong application of relevant concepts, skills, and problem-solving abilities. What does this mean? Students must be trained to be literate citizens in a culture increasingly dependent on computers. Students—especially females, who predominate in clerical and service occupations—must be educated to move beyond word processing and presentation software to solve real-life problems with technology. While a tally of girls in computer science classes is a convenient benchmark, empowering girls and other nontraditional users to mine computer technology for sophisticated, innovative uses requires a mastery of these literacies and abilities, not quickly outdated programming skills alone. (See “What Is Fluency with Information Technology?” on page xi.)

Respect multiple points of entry. Different children will encounter different entry points into comput-

ing—some through art, for example, some through design, some through mathematics. These multiple entry points need to be respected and encouraged, while we remain sensitive to activities and perspectives that are appealing to girls and young women.

Change the public face of computing. Make the public face of women in computing correspond to the reality rather than the stereotype. Girls tend to imagine that computer professionals live in a solitary, anti-social, and sedentary world. This is an alienating—and incorrect—perception of careers that will rely heavily on computer technology and expertise in this century.

Prepare tech-savvy teachers. Schools of education have a special responsibility: They need to develop teachers who are able to design curricula that incorporate technology in a way that is inclusive of all students. Schools of education also must be able to assess “success” for students and teachers in a tech-rich classroom. The focus for professional development needs to shift from mastery of the hardware to the design of classroom materials, curricula, and teaching styles that complement computer technology.

Begin a discussion on equity for educational stakeholders. A more equitable and inclusive computer culture depends on consciousness-raising within schools about issues of gender, race, and class. School districts should put in place institutional mechanisms that will facilitate such conversations in partnership with parents, community leaders, and representatives from the computer and software industry.

Educate students about technology and the future of work. Schools have a message to communicate about the future of work: All jobs, including those in the arts, medicine, law, design, literature, and the helping professions, will involve more and more computing. Conversely, technological careers will increas-

ingly draw on the humanities, social science, and “people skills.” It is especially important that girls not bound immediately for college understand career options in computer and network support, and the impact of new technologies on more traditional fields.

Rethink educational software and computer games. Educational software and games have too often shown significant gender bias. Girls need to recognize themselves in the culture of computing. Software should speak to their interests and girls should be treated as early as possible as designers, rather than mere end users, of software and games.

Support efforts that give girls and women a boost into the pipeline. Create and support computing clubs and summer school classes for girls, mentoring programs, science fairs, and programs that encourage girls to see themselves as capable of careers in technology.