Closing Gender Gaps in Science

Advanced placement science and technology teachers examine gender bias in their teaching practices.

Jo Sanders and Sarah Cotton Nelson


© John Booz

High school students across the United States, hoping to get a head start on their college credits, took 1,700,000 advanced placement (AP) exams in 34 subjects in 2003. Students who take these exams tend to be the more ambitious ones. The presence of AP exams in a school's curriculum is a good indication of where tomorrow's academic high achievers will be coming from and what fields these students might enter.

An interesting aspect of the AP exams is how lopsided many of them are by gender. Girls constitute the majority of test takers of many of the exams—66 percent in art history, for example, and 64 percent in English literature and composition. These female-dominant imbalances can create serious gender issues for boys: It's not healthy for us as a society, or for boys individually, to think that excellence in reading and writing is "feminine."

As for the male-dominant imbalances, girls used to be a minority in AP exams on mathematics, biology, and chemistry, but these numbers have equalized in recent years to the point where girls make up roughly half the test takers in these subjects.

The AP exams of continuing concern for girls since the 1970s are the three physics exams (the AP Physics B exam, the AP Physics C exam on electricity and magnetism, and the AP Physics C exam on mechanics) and the two computer science exams (CS-A and the more advanced CS-AB). Figure 1 (p. 76) shows girls' presence nationwide in AP physics and computer science as well as in other mathematics and science subjects in the 2003 AP exams.

In computer science, girls' track record has actually worsened. In 1992, girls represented 21 percent of the CS-A test takers and 13 percent of the CS-AB test takers, compared with 16 percent and 10 percent respectively in 2003. The 2003 numbers show an average of only 44 girls in each state taking the CS-A exam and a mere 14 girls in each state taking the CS-AB exam.

Enrollments in AP physics and computer science remain primarily male.

© Susie Fitzhugh

When many *Educational Leadership* readers went to high school, students were exhorted to take as much mathematics as possible because math, we were told, was the key to a whole raft of high-paying, high-status careers in technical areas. For the new generation, however, science and technology have replaced math as the gateways to a wide variety of technical careers in the sciences and in engineering. When high school girls represent only one-fourth to one-third of students enrolled in AP physics—and when they represent an even smaller portion of those enrolled in computer science—they are deprived of an important leg up to technology-related majors in college. Girls' underrepresentation in these fields must be taken seriously because society simply cannot afford to waste this much talent.

Data on Gender Disparity

In Dallas, Texas, enrollments in the AP mathematics and the AP biology courses are fairly equally balanced in terms of gender, but enrollments in AP physics and computer science remain primarily male. These patterns mirror the national situation. Further, the pass rates in Dallas on AP exams in physics and computer science were found to be substantially lower for girls than for boys.

We discovered that the problem went far beyond gender imbalances in AP course enrollment and test taking. To test a frequently heard argument—that boys are simply better suited to higher-level math and science—we correlated girls' and boys' PSAT math scores in the Dallas Independent School District with their pass rates on the AP exams in science and technology. It was a revelation: Girls who scored in the 70s in PSAT math (a score equivalent to a 700 in the SAT) scored considerably lower in the AP exams than equally qualified boys did.

For instance, all the boys who scored 70 or above in the PSAT math exam passed the AP chemistry exam; the same was true for only 50 percent of the high-scoring girls. In the Physics C exam on mechanics, the pass rate for boys who scored 70 or above in the PSAT math exam was 94 percent; for girls in the same category, the pass rate was 71 percent. Six of the nine boys who scored 70 or above in the math exam passed Physics B, but none of the four girls who took Physics B passed it. In Computer Science AB, the pass rates for boys and girls who scored 70 or above in the PSAT math exam were 44 percent and 25 percent respectively.

Therefore, not only do fewer girls in Dallas take the science and technology exams to begin with, but girls with high ability as measured by their PSAT math exams also score lower in their AP exams than comparably qualified boys do. What's going on that would lead to such gender disparities among students who sit in the same classrooms and learn from the same teachers?

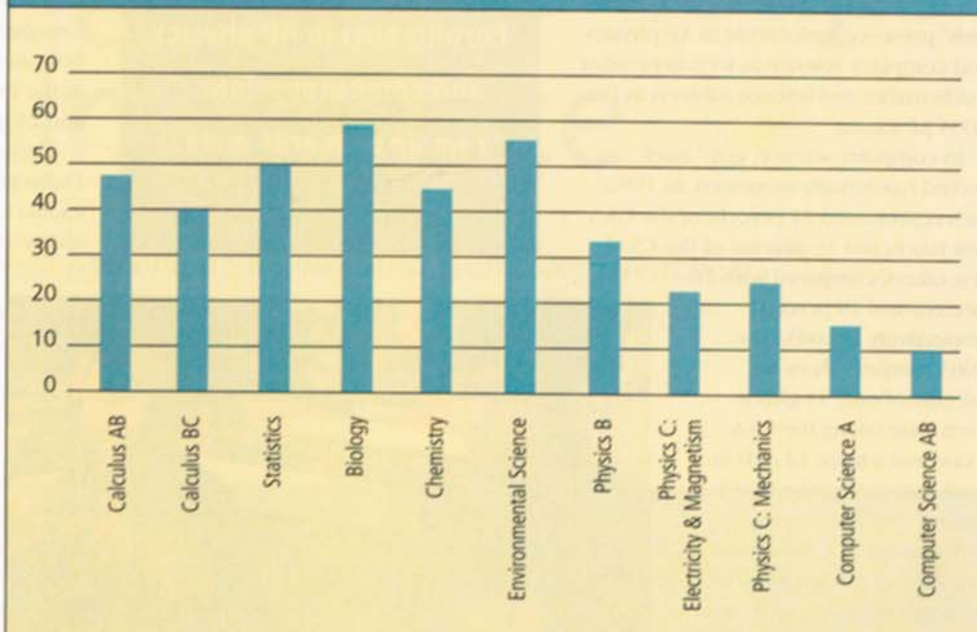
Four interested parties decided to find out: the Dallas Independent School District; several women employees from Texas Instruments; the Dallas Women's Foundation; and AP Strategies, a not-for-profit agency in Texas that works to improve student pass rates in the state on AP exams. Together, these four parties created a program to advance girls' participation and performance in AP science and technology in Dallas high schools: the Dallas Gender Equity Project.[1]

The Dallas Gender Equity Project

The Dallas Gender Equity Project began in October 2003 with a full-day workshop for 14 teachers of AP chemistry, physics, and technology courses in Dallas high schools. The workshop instructor presented the data on girls' underachievement in Dallas AP exams. Despite some initial skepticism about gender equity, the data-oriented science and technology teachers were curious about the causes of the imbalance. The teachers talked at length about the gender issues they were seeing in their classes and about the efforts they had made to deal with the disparity. Some pointed out their unsuccessful efforts to recruit girls for their classes; others noted the girls' reticence to speak up in class despite invitations to do so.

Every few months for the rest of the school year, participants met in half-day follow-up workshops held after school. Before each workshop, teachers completed mini-assignments that focused on gender issues surfacing in such venues as toy stores, Saturday morning television shows, or magazines and Web sites familiar to high school students. Other mini-assignments dealt more directly with school, requiring participants to look for gender bias in textbooks, in teacher-student interactions, and even in classroom wall displays.

FIGURE 1 Percentage of AP Exam Takers Who Are Female (2003)



Source: College Entrance Examination Board. (2003). *School AP Grade Distributions, National Totals.* Princeton, NJ: Author.

Each workshop focused on a specific topic, such as teacher expectations and stereotype threat, interpersonal dynamics among minority and nonminority groups, and curriculum bias. The instructor also introduced interesting research studies on gender in science or technology. In fact, one of the program's strengths was that it addressed the gender issue with solid data. Physics teacher and workshop participant Rebecca McGowan Jensen explained,

> We were given real data from education journals, the context in which to understand [this information], and concrete methods to change our classroom instruction and get quantifiable results. We were treated as collaborators rather than people to be lectured at.

Reality Versus Perception

Teachers brought fascinating stories back to the group from classroom experimentation. Daniel Brown, an AP physics teacher, reported that he had initially been skeptical of any gender inequity in his classroom. "Maybe in other teachers' classrooms," he insisted, "but certainly not in mine." He set out to prove the statistics wrong for his classroom by conducting an experiment.

He asked a teacher to observe his class and time his responses to both his male and female students. This was a gender issue that one of the earlier workshops had tackled. Just knowing that someone was clocking him during that period made him extra aware; he was all the more certain that his time allocation would be fair. At the end of the class, his colleague showed him the results: Taking into account the class's gender representation, the teacher had spent 80 percent of his time responding to boys and 20 percent to girls. "It absolutely bowled me over," Brown said.

He worked hard the next month on implementing strategies presented in the workshops to make the classroom environment more gender-equitable. Making changes in his teaching practice meant becoming aware of a number of gender-based patterns that are below most teachers' level of conscious awareness. He paid attention to which students he called on, how much time he spent waiting for their responses, how much eye contact he maintained, which types of questions he asked specific students, and whether he accepted or refused called-out answers.

Once again, he asked his colleague to observe him in class. During that period of observation, he felt that he had gone overboard in his attention to the girls. He was sure that the observing teacher would tell him that he had swung the pendulum completely back the other way—that he was now spending 80 percent of his time responding to girls and 20 percent to boys. At the end of the period, the observing teacher told him the results: "Fifty-fifty, dead on."

Changes in the Classroom

Science teacher Chris Bruhn, a former aerospace engineer, appreciated the need for getting more girls into technical fields and had experienced similar gender imbalances in science classrooms. Said Bruhn,

> When I was in college, there were at least five boys for every girl in the engineering classes. My graduating class of 30 aerospace engineers included only one female, and I soon learned that the workforce was not much different. One of my missions when I became a physics teacher was to convince more girls to become engineers.

Bruhn experimented with two gender-related activities in his high school physics classes. The results were eye-opening. In the first experiment, he asked students to determine the tension in a string suspended from the ceiling. At the end of the string was a toy eagle that could "fly" around in a circle. He gave no instructions for getting the eagle to fly or suggestions about equipment to use, measurements to make, or equations to apply. Although there were several ways to determine the string's tension, solving the problem really only required a stopwatch, a meter stick, and a balance. He asked the girls to set up the equipment and the boys to record the data. This resulted, in his words, "in a meltdown in the classroom." According to Bruhn,

> The girls did not want to do it! "We don't know how to do it," they said. "Can the boys set it up?" Of course, the boys were all too eager to do it for them. This was an appalling surprise to me. Needless to say, I had a lot of work to do, but by the end of the year the girls were just as possessive of the lab equipment as the boys were.

In the second experiment, Bruhn videotaped a class period. When he watched the tape, he discovered that he was allowing boys to interrupt the girls. "This had the effect of rewarding the boys for being outspoken and rewarding the girls for being quiet," he said. "This was the exact opposite of what I wanted." Bruhn then explained to the students why he had videotaped the class and what he had found. The students were intrigued and a discussion followed of what the teacher had been learning in the Gender Equity Project. In subsequent classes, the boys began to apologize when they interrupted the girls or when they tried to take over; they eventually learned to wait their turn. Just as important, the girls learned to stand their ground during discussions in class, and they took on positions of leadership.

Daniel Brown noticed similar changes when he began to focus on the girls in his class. The girls became more confident that they could do physics, they participated more in class, and they learned to deal more effectively with some of the disruptive male behaviors. Brown revised his teaching style in all six of his classes; in three of them, he specifically announced the changes he was making and his reasons for making them because the subject happened to come up in class. The girls pointed out that they had not even noticed anything wrong with his teaching style because they were so used to it.

"Each student needs to feel that she is competent, important, and talented."

Changes entailed making sure to ask both girls and boys deeper follow-up questions, calling on girls as often as on boys, and refusing to permit the boys to interrupt the girls. In the classes in which he made the announcement, the girls became even bolder and more confident than the girls in the other three classes. According to Brown, making this conscious effort every period of every day prevented him from "slipping back into his old ways."

Changes in Brown's teaching practices have resulted in enrollments in AP physics jumping from four girls out of 13 students in the 2003–2004 school year to 10 out of 20 for the 2004–2005 school year, or from 31 percent to 50 percent female. He has seen a dramatic increase in minority enrollment as well.

What's Next?

Gender-equitable teaching practices have started flowing into mainstream Dallas schools. The Gender Equity Institute, supported by the Women of TI Fund, was initiated this year at the University of Texas at Arlington to serve both teacher education students and classroom teachers seeking continuing education credits. A gender equity component will be included in a math training program for teachers. In addition, other local school districts are becoming interested in adopting the Gender Equity Project approach.

Gender equity activities continue to thrive in Dallas high schools. Several "booster shot" workshops will take place during the 2004–2005 school year, with a whole new round of workshops scheduled for teachers who teach pre-AP classes. High school principals and counselors have already attended an evening workshop on gender equity. Female students of science, technology, and engineering from Southern Methodist University in Dallas and women from Texas Instruments who are involved in technical careers have volunteered to attend the sessions.

Commenting on the program, one physics teacher said,

> The most important lesson I took away for my female students was this: Each student needs to feel that she is competent, important, and talented. The number one thing we can do for a student is to sit her down, look her in the eye, and tell her that she's good at this subject.

And this is what we did. No one can change the world entirely, but we found that focusing on gender equity in our classrooms helped us change a bit of it. EL

[1]Several women who work at Texas Instruments (TI) collectively fund a number of projects dealing with gender and technology through the Women of TI Fund. The funds collected by the Women of TI are administered by the not-for-profit Dallas Women's Foundation. The project's other not-for-profit partner is AP Strategies, through which the grant was conducted. AP Strategies works closely with the Dallas Independent School District and has access to the data necessary for tracking the project's success.

Authors' note: The following people contributed to this article: Rebecca McGowan Jensen, Jon Papp, Daniel Brown, Chris Bruhn, and Walter Dewar.

Jo Sanders is a gender equity consultant; jo@josanders.com. **Sarah Cotton Nelson** is Director of Grants and Research at the Dallas Women's Foundation; snelson @dallaswomensfoundation.org.