COMPILATION: Gender, FCI, and advanced physics enrollments

Date: Fri, 25 Apr 2003
From: "Booker, Melissa" <Melissa.Booker@FCPS.EDU>
Subject: gender and the FCI

I gave my FCI post-test several weeks ago, and after I analyzed the data I was surprised by the gender gap in scores.

I teach both juniors and seniors. I noticed a gender gap both when I looked at both grades together and most pronouncedly when I looked at the juniors. Junior boys (post-test ave=64%) had, as a group, the highest average and a 7% greater average score than junior girls, and they outscored senior girls by 14%. My classes are pretty close to a 1:1 gender ratio.

Has anyone tried to reason through the gender gap? I've read some published articles about the gender gap on the FCI and I didn't find much conclusive evidence about why this is happening. Grades for boys and girls actually go the other way--girls' grades are generally higher than boys, but this follows most published data about grades for boys and girls in high school.

The gender gap concerns me. There still remains a gap in the number of girls taking AP Physics all over the US (I've seen this data published by NSF every couple of years and by AAUW) and my school reflects these gaps--only 15% of our AP Physics C students are girls. I usually get two to three students from all my regular (I don't teach honors) classes to take AP Physics C the next year (and they do very well--hoorah modeling), but hardly ever are these students girls despite the fact that I specifically pull girls aside to talk with them about taking AP Physics.

Date: Sat, 26 Apr 2003
From: David Koch <chagrined@EV1.NET>

I don't have any hard evidence, only my 37+ years' experience. I've taught in public schools in two states, a private boys' boarding school, and two private girls' schools. I am at a girls' school now. When I came to the first girls' school it was from a good public school where I too had about a 1:1 ratio of boys to girls. Like Melissa, more boys were at the top than girls, though some of the girls did exceptionally well. When I first arrived at the girls' school, I used the same teaching approach, text, level of difficulty, etc. It resulted in tears, unhappy students, and a visit by the mother of one student concerned about it all. A modification of my approach was necessary. After 16 years at two girls' schools I believe that the largest difference between the way girls and boys work in physics is that the motivated boys become interested in a subject, say physics, and go after all they can. *The motivated girls, on the other hand, may like it just as much, but their interests seem wider than the boys' interests.* The girls want to try everything. They cram in every course they can squeeze into their schedules. This doesn't allow for the intensity of the work I used to require at the public school.

Yet, the girls do as well in college. Since I began using a modeling approach in 1995, I would say (sorry, no hard data) that I've seen more girls go into physical sciences and engineering in college, than ever before. And they are successful.

Date: Sat, 26 Apr 2003
From: Jane Jackson <Jane.jackson@ASU.EDU>

On April 25, Melissa Booker, a modeler in Washington, D.C., posted: *"There still remains a gap in the number of girls taking AP Physics all over the US (I've seen this data published by NSF every couple of years and by AAUW) and my school reflects these gaps--only 15% of our AP Physics C students are girls."*

Coincidentally, that same day Richard Hake posted to PHYSLRNR, PHYSHARE, PHYS-L, and AP-PHYSICS listservs this quote by physics Nobelist Dr. Leon Lederman, in regard to positive effects of the Physics First sequence.

"We hear that after the new sequence is installed, increases take place in fourth-year science electives, enrollment in AP science courses zooms up, college successes are recorded, and then, here is the funny thing, there is a dramatic effect on women and minority students from poor families who come into high school without a strong positive science and math experience. Many

of these. . .(new sequence). . .schools tell us things like 'AP physics now has 53% women.' I remember AP physics as having one, two, or no women. What is going on?"

THIS IS AN ANECDOTE. WE NEED DATA! It's easy to get. Do you use the *Physics First* sequence? If so, what fraction of your AP (or 2nd year) physics courses are girls?

Date: Sat, 26 Apr 2003
From: John Clement <clement@HAL-PC.ORG>

Perhaps the AP curriculum and the methods of teaching AP do not mesh with women's way of knowing. There is some indication that reformed physics teaching does mesh better. The most telling data was the study which found that after a reformed course, women did better on the MCAT, but in a conventional course they fell below their male peers. The males however did about the same under both methods.

Date: Sun, 27 Apr 2003
From: Mary McGowan <CKOZUMPLIK@AOL.COM>

I taught 12 years in an all girls school that went to *"physics first"* during my last 7 or 8 years there. *Enrollment in 2nd year physics and chemistry courses and in all advanced elective science courses increased dramatically with the introduction of physics first, as did girls entering physics, chemistry and engineering programs as college freshmen.* Sorry I have no FCI scores for the pre-modeling physics first girls there that you can compare with post-modeling *physics first* girls, but interest in all things physics certainly bloomed with the inversion of science sequence.

Date: Mon, 28 Apr 2003
From: Paul Wendel <pwendel@KENT.EDU>

1. In ISSUES OF GENDER, TALKING ABOUT LEAVING: WHY UNDERGRADUATES LEAVE THE SCIENCES, Elaine Seymour and Nancy M. Hewitt wrestle with the fact that women leave the sciences at higher rates than men. Although the reasons are complex, the data of Seymour and Hewitt clearly indicate that while the male and female students were undifferentiated in ability or preparation, conceptual difficulties are a factor: "Female switchers generally report more conceptual difficulties than do male switchers (33.3\% vs. 20.2\%), and more academic problems which they view as serious enough to be a factor in their switching decisions" (p. 239).

Maybe this means that the females are having more conceptual trouble in the conventional classroom. On the other hand, maybe the males have an equal amount of conceptual difficulty, but females are more aware of it. (If this is the case, the females may be more self-aware.) Also, I don't know how Seymour and Hewitt define (or measure) "conceptual difficulties;" maybe it has nothing to do with FCI-level concepts. Anyway, it's something to think about.
Ref: Elaine Seymour and Nancy M. Hewitt, ISSUES OF GENDER, TALKING ABOUT LEAVING: WHY UNDERGRADUATES LEAVE THE SCIENCES, Westview Press, Boulder, Colorado, 1997, pp. 231-318.

2. A study at the University of Arkansas showed that following traditional calculus-based physics instruction, the confidence level of women was significantly lower than the confidence level of men in all of the ten categories measured. However, when interactive-engagement methods were introduced into the course, "post-test results show that all the students were more confident in every category, but the women gained more than the men, their confidences being not significantly different from the men's in eight of the categories" (p. 33).

This would indicate that reformed teaching methods (such as modeling) are more helpful to women than men.
Ref: Gay Stewart and Jon Osborn, "Closing the Gender Gap in Student Confidence: Results from a University of Arkansas Physics Class," *Journal of Women and Minorities in Science and Engineering*, 1998, 27-42.

3. Males tend to be more aggressive in the classroom. (I can't cite any research on this, but I'm pretty sure it's true.) Since a foundational idea behind interactive-engagement teaching techniques

(such as modeling) is that we learn through discourse, perhaps the males tend to dominate the discourse in the classroom, thereby leaving the females in the position of "passive learner."

Date: Tue, 29 Apr 2003
From: Marc Reif <mreif@FAYAR.NET>

Although I haven't had time to look at my meager amount (2 years) of FCI data, I would concur anecdotally that a gender gap exists. Fewer of the AP calculus females take physics, and females drop physics more readily, even when all the indications are that they will be successful in it (to me, at least). Females seem to be less confident with physics, and that appears to be a possible reason for the gap. My impression is that many of the best female students have succeeded by being "good little students" and doing everything the teacher has asked of them, while the boys tend to function more independently of teacher expectations. When they get into a class where taking good notes and memorizing everything doesn't really help you succeed, the girls are less confident.

My response has been to make my thoughts on the subject explicit. Early on in the year, I let the students choose their own groups, and I encourage the girls to segregate by gender. I mention in brief that I have observed the one girl in a group, even if she is by far the best physics student in the group, to sit back and let the boys do everything (perhaps not by choice). I also talk about how even though girls test as well or even better than boys in general, fewer of them go into science and mathematics. And state explicitly that this appears to be independent of ability. With girls in some classes, this gets to be a bit of a running joke, i.e. "Don't let any of those boys in our group." Although I don't always let them choose their own groups, this at least brings up the issue.

Date: Mon, 5 May 2003
From: "Kathleen A. Harper" <harper.217@OSU.EDU>

When the current question about gender and the FCI started, I got in contact with Laura McCullough at UW-Stout and asked her to comment. This is Laura's area of research.

She sent me the following:

Gender and the FCI: Current research

by Laura McCullough

What happens with the FCI and women? Is there a gender gap on the FCI for those students who take it? Yes! At high school, college, and university levels, women don't score as highly as men do on the FCI. The gender gap varies from 5 to 25 percentage points usually. I have seen this at many different types of institutions: high school, prep school, small college, Research One university, etc. I also have heard from many teachers that they have noticed an FCI gender gap in their own classroom, though I haven't seen data from these people.

The gender gap doesn't go away pre-test to post-test, though the type of instruction can affect the size of the gender gap. Active learning instruction may do better at reducing the gender gap for the colleges and universities we have studied.

Ref: "Gender, Educational Reform, and Instructional Assessment, Part II." available at http://physics.uwstout.edu/staff/mccullough/physicseduc.htm#Presentations

Previous physics background doesn't reduce the gender gap. Broken out by previous physics experience, the gender gap still persists.

Ref. "Gender, Educational Reform, and Instructional Assessment, Part I." available at http://physics.uwstout.edu/staff/mccullough/physicseduc.htm#Presentations

The context of the questions does seem to affect student response, but so far I have not been able to consistently cause higher or lower scores. This is my current research area. What I have found is that changing the context from male to female orientation causes scores on particular questions to vary wildly.

A really old look at the FCI and gender:
"Gender Differences on Multiple-Choice Conceptual Tests"

Talks about my version of the FCI and context-dependence:
"A Gender Context for the Force Concept Inventory"

"Gender, Context, and the FCI: Further Studies"
"Differences in male/female response patterns on alternative-format versions of FCI items".

There are a very few other papers I have found which look at gender and the FCI:

Grim, N. (1999), "A force concept correlation study with instructional methods, anxiety, perceptions of difficulty and student background variables." Report available through ERIC (I got it off the web).
Willson, V. L., Ackerman, C., Malave, C. (2000), "Cross-time attitudes, concept formation, and achievement in college freshman physics." JRST 37(10) 1112-1120.

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