Keeping Women in Physics is More Than a Numbers Game

In intro-to-physics classes containing more women than men, women still feel out of place, implying that more needs to be done to make physics classrooms feel inclusive.

By **Katherine Wright**

Despite decades of trying, universities in the US have barely moved the needle on the percentage of women studying physics and then making it a career. The most recent data from the National Science Foundation shows that 21% of physics Ph.D.s in 2018 were awarded to women, up just two percentage points from the 2008 figures. Studies also show that women are more likely than men to feel out of place in a physics class, something that has been directly linked to this underrepresentation.

These prior studies all considered physics classes in which men dominated the lecture hall, leaving open the question of whether the outcome might be different if women were to make up the majority (Fig. **1**). To look at exactly that problem, Sonja Cwik and Chandralekha Singh of the University of Pittsburgh surveyed students in two mandatory introductory physics courses for bioscience majors, where around two-thirds of the participants were women [**1**, **2**]. They found the same outcome—the women were more likely to feel that they didn't belong in the room and that the instructor didn't think that they should be there.

Even when they make up the majority, women are more likely than men to feel out of place in a physics classroom.
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The researchers say that a major cause of women feeling like "impostors" is the perpetuation by instructors, through their teaching styles, of negative societal stereotypes about women physicists. "The physics departments and the physics instructors are not recognizing their own role in perpetuating the gender gap," Singh says. However, the duo thinks the problem can be easily fixed. "We need to create an inclusive culture where it's clear that everyone belongs," Singh says.

For their studies, Cwik and Singh conducted two surveys. The first survey looked at belonging and was completed by 814 students (64% women) taking an intro-to-physics class. The second survey was given to a different class of 827 students (67% women), who were asked about perceived recognition—whether a student felt that other people saw them as capable of succeeding in physics. In both cases, the students were surveyed at the beginning of the course and then at the end. Cwik and Singh also conducted one-on-one interviews with students and had access to the students' high school grade point averages (GPAs)—a common measure of academic performance—and their final grades in the intro-to-physics class.

Analyzing the data for the first class, Cwik and Singh found that

the women there reported a lower sense of belonging than the men. This sense of belonging was predictive of the students' final grades, which were lower for women than men, despite the women having, on average, higher high school GPAs. In addition, while the sense of belonging increased for the men from the beginning to the end of the class, it remained unchanged for the women. "It's a little concerning that the women were doing better in high school overall but are doing worse in this physics course," Cwik says. "There is clearly some disconnect."

The duo found the same disconnect in the other class. In that case, the women had a significantly lower perceived recognition. This perceived recognition decreased over the course of the class, leading to a larger gender gap at the end than at the beginning. Again, the women received lower grades but had higher high school GPAs. These results clearly indicate that physics identity has "less to do with the numerical representation of different groups of people in the class," Singh says.

So, what are the causes? Both Cwik and Singh say that one major factor is the learning environment. Studies show that if the learning environment is perceived as exclusive and inequitable, then students from marginalized backgrounds are more likely to feel unsafe or judged. "That makes it less likely that they will fully participate in whatever is happening," Singh says. "They feel like outsiders."

One solution to that problem is to create an inclusive learning environment that helps all students excel. To do that, Cwik says, instructors can open courses with testimonials from past students and from physics faculty that make it clear to students that struggling with a problem is normal; people at all stages of their physics career come up against questions that they can't answer. The testimonials normalize adversity and show that it's a stepping-stone on the learning journey, she adds. Cwik and Singh have seen that when such efforts are made, the sense of belonging—and the grades—of the women students increase. "A short activity like that can really help reduce the gender gap," Singh says.

Other concrete actions include avoiding words such as "easy" and "trivial" to describe a practice problem—those words can alienate students who find the problem hard—and making sure that all students are equally called upon to answer questions. "If instructors are always asking John, Jason, and Steve to answer questions, then people who don't look like John, Jason, and Steve, can feel like they don't belong, that they don't have what it takes to excel," Singh says. That is antithetical to what physics departments should be trying to achieve, she adds. "We want every student to feel recognized and to think that they belong."

Katherine Wright is the Deputy Editor of *Physics*.

REFERENCES

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2. S. Cwik and C. Singh, "Not feeling recognized as a physics person by instructors and teaching assistants is correlated with female students' lower grades," **Phys. Rev. Phys. Educ. Res. 18, 010138 (2022).**