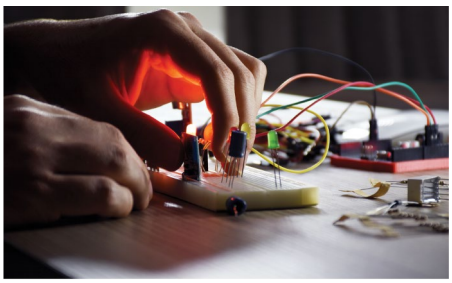
https://doi.org/10.1038/s41567-024-02458-4

Unlock the potential of a physics education

This month in *Nature Physics*, we publish a Focus issue that highlights the importance of physics education research.



Physics curricula and education systems have remained largely unchanged for decades, and much can be done to improve them. For example, the well-documented lack of diversity in physics starts at undergraduate level. As a result, much potential talent is missed and the under-representation of minoritized groups is amplified at each career stage. Additionally, the aim of many physics courses is still to train students to work in academia, thus making graduates less prepared for careers in industry.

A Focus in this month's issue of *Nature Physics* provides an overview of the current state of physics education research and offers recommendations on how to make learning environments more equitable and inclusive, diversify graduates' skillsets and enable them to tackle important societal issues and challenges.

With teaching sometimes perceived as being forced on researchers as one of the many additional tasks they must accomplish and with little departmental support, tackling inequity and updating curricula can feel overwhelming. However, a Review about equity and inclusion in physics learning environments by Chandralekha Singh and Alexandru Maries stresses that a physics instructor's mindset and intentions can have a significant impact on the diversity in physics courses.

Unthinking comments about the 'triviality' of an assignment or preconceptions about who can and cannot do physics will have hugely damaging effects on people from minoritized groups. Informing oneself of the effects of one's attitude during teaching can be the first step to prevent setting up courses that widen existing gaps in achievement. These actions at the individual level must be supported by departments. Singh and Maries provide structural advice for physics departments as a whole and emphasize that simple interventions can empower all students.

In a similar vein, a Comment by Geraldine Cochran and coauthors analyses the specific example of racial equity in physics education research. They highlight that much research up until now has focused on elite universities with predominantly white student populations and advocate for an emphasis (both in focus and in funding) on intersectional research aimed at decolonizing physics research.

On a more practical level, the Focus issue includes two pieces about how to structure physics courses and how best to engage with the Gen-Zers — often defined as those born between 1997 and 2012 — who make up the majority of today's undergraduate classes. In a Comment that discusses how to put together a physics curriculum for these so-called digital natives, Jenaro Guisasola and Kristina Zuza discuss the benefits of a student-centred active learning approach in physics courses. They argue that traditional, lecture-based methods are insufficient to prepare students for the increasingly wide range of potential careers outside of academia. Such active teaching should be done in conjunction with diversity, equity and inclusion discussions, and students should be encouraged to consider their identity as physicists and their role in society.

The benefits of active learning are further elaborated in a Perspective that places them in the context of the current generation of learners. Nam-Hwa Kang emphasizes the importance of considering the defining characteristics of the students currently going through the education system in order to set up an effective curriculum. Today's students are unlikely to be satisfied with traditional teaching styles and need an education structure that lets them take responsibility for their own learning with the help of digital technology. This approach will not only benefit students' understanding of physics but will also help them effect change in the world around them.

On the topic of digital technology, a Comment by Marcos D. Caballero and Tor Ole Odden describes how to effectively integrate scientific computing into undergraduate physics courses. As the reach and importance of computing grows, it is crucial that students understand its power and pitfalls. This is valuable transferrable knowledge that will help regardless of whether the students continue into academia or take jobs elsewhere.

We at *Nature Physics* publish this Focus issue to highlight both the importance of physics education research and our interest in publishing primary research in this field. We would like to invite the physics education research community to consider submitting their work to our journal.

If physics research is to become more useful and physics groups more diverse, innovating in physics education systems is a good place to start. Physics departments should give more attention and resources to teaching to help all students feel like valued members of the physics community. Make teaching more equitable and relevant so that everyone can thrive.

Published online: 14 March 2024