

Prosthetic

Power

STORY BY
ALISON FRYE

"Let me fix your disability and make you

as able-bodied as possible with this prosthetic." Wait. Scratch that.

Start over.

PHOTOS BY
LAURA STEWART
AND
ANN-MARIE WHITE

"What's most beneficial to **you**, the client, and **your** individual needs and wants?"

Now we're talking. >>

An Innovative Marriage of Engineering and Advocacy

Born a congenital double amputee, with a partial right foot and a right arm ending at the wrist, Izabel Estrin, at age 23, is an NYU graduate, an actor, and an advocate, disabled and proud. And last spring, Putney's Engineering and Design class was tasked with creating for her a new prosthetic foot.

"I acted as their client, as if they were an actual engineering company I hired to design a new prosthetic foot for me," reported Izabel. Students had access to scanning programs, coding programs, 3D printers, and all of the necessary materials. But first—very importantly—the students learned lessons in disability rights, history, and culture. Their worldview expanded to see that we live in an ableist society, and we go to an ableist school.

The class focused on human-centered design. How does a person's lens shift when they ask if the *system* is the issue? "We talked about sidewalks," said teacher Ann-Marie White. "You could look at someone who is physically disabled and think, 'look at that person who can't get up on the sidewalk,' or, you could think, 'look at that sidewalk that's not helpful for all people.' *That's* the shift that we made in this class."

The *New York Times* pioneered a "Disability" column starting in 2016, and in 2020, the paper marked the 30th anniversary of the Americans with Disabilities Act with a series of articles celebrating people with disabilities, as well as reflecting on the progress our society has made since the signing of the bill and highlighting the ways we continue to fall short [see sidebar].

Izabel's advice echoed that offered in the *Times* series: don't try to solve problems that don't exist. Blind people generally like their white canes. A prosthetic arm does not necessarily need to have a hand, because it offers little use. Likewise, Izabel, born with a partial foot and an ankle joint, needs a prosthetic that gives her a pivot point, but does not need toes. Those cosmetic touches exist to make able-bodied people more comfortable.

So, then, what problem did the class fix? What did the students learn?

This page, clockwise: Izabel out and about in Bellows Falls; molds and models as works in process; Opposite page: Skylar '24 uses his iPhone and the Polycam app to scan the prosthetic foot the class worked to replace



PHOTO COURTESY OF IZABEL ESTRIN

Enter Technology

An estimated 100 million people worldwide use a prosthetic or orthotic to support a damaged limb. The expense and delay of acquiring a prosthetic create hurdles, some insurmountable, for many of those in need.

But now, 3D printers and computer-assisted design programs might create a bypass to traditional systems, offering access where it did not previously exist. "The professional orthotics and prosthetics industry is almost fully reliant on traditional materials like silicone, plasters, and carbon fiber. Those prosthetics are expensive, take a long time to make, and are often inaccessible to someone without health insurance," said Izabel. "We think 3D printing could be an incredible solution to this, because if we are able to figure out prosthetic designs that actually work, we could in theory create digital files, and the client who needs the prosthetic could obtain the file, go to a local makerspace, and get a new prosthetic printed whenever they need one." Stop and think about that. Doesn't that blow your mind? How would that work?



First, a note on the equipment, as it remains unfamiliar to many of us. One could easily mistake 3D-printer filament for the coated electrical wire found in a hardware store. It's a colorful empty canvas of varying materials, spooled and ready to go. The 3D printer in the Reynolds Building lives in what looks like an empty terrarium. You almost expect to see a pet tarantula hiding in its corner. Inside this glass box, you find a crane-like structure (a small one), a handful of wires, and not much else. Students use computer programs to create designs, and presto changeo, the printer slowly turns the design into a tangible *thing*.

The class at Putney used Polycam to 3D-scan Izabel's foot. These measurements went into Fusion 360, and the students designed 3D-printable prosthetics, using the scan of the foot as a reference to create molds from which the prosthetics were then built. The first prototype fit, but the material was too rigid, its sharp edges uncomfortable. Back to the drawing board, changing the material, skimming off another millimeter, figuring out the front, and then finding the back didn't work. Prototype after prototype, the students worked for eight weeks with an eye to the needs of the client, focusing on strength, flexibility, and comfort. They had to create something both comfortable

and useful. The precision and detail of the iterative process was invaluable in the course. The disability aspect gave the class depth and meaning—it was all about what Izabel wanted.

"It was practical, and we were helping somebody. 3D-printing a silicone foot is new technology, and we came up with new ideas. The class was a mix of getting better at what we already knew, learning new things, and working as a team to have a product," said Owen Bonneau '23. In eight weeks, they created a prosthetic that really works. And while they are still figuring out how to get it secure around Izabel's foot, she *can* wear it. Material cost? About \$30.

The size of both the class and the client base will double next year.

Nothing About Us Without Us

Reflecting on the class and looking forward, Ann-Marie offers this perspective: "It shifts what it means to be in community. We can engineer, design, and build the things we love, but if we're in community, we have to think about the needs of others. This class pulls together so much of what Carmelita Hinton talked about. Using your hands in service of someone else's need." John Dewey died in 1952. What does progressive education look like now? How does Putney stay on the leading edge? We ask ourselves that question often, and in this class, we saw an answer. "Let's use our creativity to build something that's useful for another person. If that's not what Carmelita Hinton was talking about, I'm not sure what is."

Nothing about us without us. Disability advocates embrace this slogan, and have trumpeted it as they fight for visibility and work with policymakers about the decisions that affect their lives. In a basement classroom, in an old building in Vermont, five teenagers lived it, with busy hands, curious minds, and open hearts.

Recommended reading

from the *New York Times*:

About Us: Essays from the Disability Series (2019)

"Disabled Do-It-Yourselfers Lead Way to Technology Gains," July 14, 2020

"Building Accessibility Into America, Literally," July 20, 2020

"How to Report With Care on Disability," February 27, 2022



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in service of
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