

Makers & Learners

A New Generation of Product Innovators

By Amy Biemiller

Not long ago, a group of children participating in a workshop at Philadelphia's Franklin Institute developed electrical circuits and engaged in design thinking and engineering. Of course, they didn't know they were learning. They were just having fun with Cirkits, a new product created by two Penn graduate students, one undergraduate and two interdisciplinary researchers in Penn's Integrated Product Design (IPD) master's program.

"It was absolutely inspiring to see the looks on children's faces when they completed the Cirkits cards—they were so excited to show their work to their friends and family," says Celia Lewis, IPD master's student and one of the innovators behind the product.

Cirkits is a sewable electronics kit complete with conductive thread, plastic sewing needles, batteries, sewable LEDs, motors and tiny microcontrollers. Adults of a certain age will remember cardboard stitch cards



designed to help children learn hand-eye coordination by stitching a long piece of yarn through holes punched around a colorful printed image. Cirkits takes this concept to a higher level, combining colorful circus animal cutouts with hands-on electronic engineering components, allowing children to bring their circus to life.

Combining Educational Forces

But before Cirkits was invented, five talented innovators had to team up within the IPD program. The program features a master's curriculum that combines courses from Penn Engineering, Penn Design and The Wharton School.

"More than seven years ago we saw the need for an interdisciplinary program that focused on product design," states Mark Yim, professor in Mechanical Engineering and Applied Mechanics and director of the



IPD program. “The process of idea generation is inherently collaborative. That is what makes it particularly difficult for universities which have boundaries between schools of design, business and engineering.”

The IPD master’s program features a learning experience that exposes students to the rigorous, technical and explorative processes in the development of both experiential and theoretical knowledge.

“IPD gives students the opportunity to work on many real-world projects that address concrete problems,” remarks Sarah Rottenberg, lecturer and associate director of IPD. “They learn how to creatively find practical answers in constrained situations, and learn to do so in a collaborative, interdisciplinary setting.”

An Innovative Sphere of Influence

The opportunity to learn in an interdisciplinary environment is what inspired Lewis to apply to the program, while Taylor Caputo wanted to expand her knowledge beyond fine arts and into product design. Choosing IPD allowed the two to hone their considerable skills in conceptualization, ideation, human-product interaction, aesthetics, manufacturing, marketing and business planning. “I love to learn through doing, and IPD was perfect for that,” says Lewis.

The IPD program is also where the two graduate students and one undergraduate communications major, Amanda Suarez, met Orkan Telhan and Yasmin Kafai, both of whom spent many years at the MIT



Celia Lewis, the design-strategist, and Taylor Caputo, the design-maker, collaborate to create a children's craft kit using electrical circuits.

Media Lab designing methods to combine science, art and technology that result in new ways for people to live, learn and express themselves. Kafai, professor in Learning Sciences at Penn's Graduate School of Education, and Telhan, assistant professor in Fine Arts at Penn Design, teach the IPD's Cultures of Making and Learning class. This is where Lewis was exposed to new and creative technologies, including sewable electronics and the LilyPad Arduino, a small programmable micro-controller board designed for wearables and e-textiles.

"I was really excited about the work we were doing and astounded by the new and different ways designers were working with technology," says Lewis. When an opportunity to do a summer research project around

electronic crafting presented itself, she and Caputo jumped at the chance. The project focused on designing new artifacts that would enhance STEM learning, such as circuit design and programming fundamentals. Their work helped them translate a craft idea into a tangible product that encourages boys and girls to play and learn about electrical engineering.

The Business of Playing and Learning

To bring Cirkits to market, Caputo and Lewis leveraged what they had learned in IPD to tackle the foundational aspects of developing a business. Lewis, Cirkits' design strategist, parlayed her background in business and design into a key role in conducting product research,



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evaluating product performance and working with users to understand their needs. “The insights from this work helped us shape what our product looked like and how it functioned,” she says.

Caputo, Cirkits’ designer, used her newfound knowledge in engineering and technical design skills to develop the Cirkits product and supported those design concepts with a greater entrepreneurial sense. “IPD gave me a stronger understanding of business and helped me make the design for Cirkits viable and profitable from a business standpoint,” she notes. “Because of the basics I learned in these classes, I was able to draft a marketing strategy, build a cost analysis and manage the project. My IPD studio classes have definitely influenced the user-testing aspect of Cirkits, and I have used these design research skills when testing our product with children and then iterating on the many prototypes we made for the project.”

Kafai oversees and guides the educational design aspects for Cirkits, while Telhan manages design and engineering decision making. “Taylor and Celia make up a good team: a design-maker and a design-strategist,” says Telhan. “Together they exhibit a unique profile because they can think of design at multiple scales, from prototyping technical details to conducting usability tests and designing a product that is ready for medium-scale fabrication.”

The product launched its first funding initiative in January with a Kickstarter campaign, which quickly earned Kickstarter Staff Pick status. “This was our first time using crowdsourcing as a model to partially fund and disseminate our research,” explains Telhan.

“My biggest hope for Cirkits is that it becomes the launch pad for a series of educational materials that combine crafts and technology, both high- and low-tech designs for learning,” adds Kafai.

Multitasking Entrepreneurship

Along with developing the Cirkits product and business model, Lewis and Caputo are partnering on their IPD thesis, developing a product similar to Cirkits. “We’ve been researching different kinds of fabrication processes and discovered that most people don’t know how many of the objects around us are made,” explains Lewis. “We’re seeking to address this gap by designing manufacturing kits that teach children about different kinds of processes— injection molding, extrusion, die cutting and more.”

In the same way that Cirkits is an intersection of design, strategy and innovation, so too is the duo’s new project. “We’re very proud of how we’ve translated various pieces of research and thought into a tangible product. Now we are pushing further to inspire children to become makers,” says Caputo. 🍷