ANGELIQUE LOUIE WAS HAVING trouble coming up with enough project ideas for her biomedical engineering students to pursue in their capstone senior design course at the University of California, Davis. So, about three years ago, the associate professor started reaching out to veterinary and medical faculty. When she joined forces with Cristina Davis, an assistant professor in mechanical and aerospace engineering, the effort went into high gear. The pair sent out solicitations to hundreds of faculty members at the school of medicine, veterinary school of medicine, and college of biological sciences. Each recipient was asked to submit "a one-page white paper on a problem – not on how to solve it – just on the problem that they needed help with," says Davis.

They hit a gold mine. Requests began to pour in for instruments that were needed but either too expensive to purchase from commercial vendors or nonexistent. Davis and Louie sorted through them to identify projects most appropriate for their five-month undergraduate senior design courses. These included such projects as the construction of a new anesthesia cart for veterinarians at the Sacramento Zoo and a specialized laryngoscope for a llama.

But of the 50 to 60 requests, Louie and Davis could accommodate only a limited number within the confines of their respective capstone courses. When applicants had to be turned away, says Davis, "we kept getting these phone calls, and we felt bad because we're the ones who got the word out."

The two professors realized that they had identified a pressing need for engineering help. Indeed, Davis was surprised to learn just how difficult it is for clinicians and veterinarians to test out ideas for medical devices on a university campus. "They have no road to prototype" a tool, she says. "They don't really know how to design it, either. They just know how they need it to work, but they need some engineers to get it designed right and then built."

Most of the clinical and veterinary departments had some amount of funding to hire someone to work on their ideas, but not enough to outsource the work to a design firm – which can get pricey. "We realized that our campus was missing out on a lot of commercialization opportunities as well as interesting didactic instruction experiences," says Davis.

And so the Design and Prototyping Clinic at UC Davis was born in early 2010. The undergraduate capstone courses still take on design projects, but applicants whose requests don't get picked up now have another option: They can hire graduate engineering students to undertake their projects, with DPC serving as "a matchmaking service."

Clients submit projects through the DPC website (http://dpc.engineering.ucdavis.edu/), and Louie and Davis then match them with graduate students who possess the appropriate skills. Clients are expected to provide funding for personnel and supplies associated with the project.

It isn't only the medical and veterinarian faculty who gain from the DPC. Most graduate students earn some money through fellowships or grants held by their supervisor. But in physics and mechanical and electrical engineering, the funding is often spread thin, so students have to support themselves by taking on an outside job or serving as a teaching assistant. The DPC eases their financial burden while providing graduate engineering students with the chance to learn to work with a client.

Understand the Problem

TASHARI ELSHEIKH, a mechanical engineering Ph.D. candidate, was the first to be matched. The project, submitted by a veterinarian, Craig Long, was to develop a new bowel biopsy tool for cats and dogs. Current biopsies require expensive surgery that involves removing tissue for analysis. Long envisioned a tool that could snake through an animal's bowels and push the tissue close to the intestinal wall so it could be analyzed by ultrasound. "Instead of having to pay for a $1,500-to-$2,000 surgery to biopsy the bowel, it may be a $100 procedure," explains Elsheikh.

Long had a design in mind, but over the course of consultations with Eksheikh and based on information the grad student gathered about similar instruments, the two men eventually settled upon what Elsheikh describes as "a simpler and more elegant design."

Long has high praise for his collaborator, who he says possesses an innovative, "MacGyver-like ability that is probably difficult to acquire in class." For his part, Elsheikh praises the process: "If Craig had gone down to the machine shop and shown the drawings to the machinist, the machinist would have just built what he had drawn," he says. "It would have cost him quite a bit of money and wouldn't have been a refined design or goal-oriented."

As a teaching assistant, Elsheikh shares lessons learned from the experience with his undergrads: "The job of the engineer is to really focus in on the problem," he says. "You can't let your sponsor lead you too much in how to fix the problem, but you do need to listen to your sponsor very well and understand what the problem is."

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Another project, undertaken first by the undergraduate capstone students, addressed a problem experienced by cancer researchers: how to produce workable wax blocks for the study of tissue samples. Clinicians embed cancerous tissue into these blocks for easier handling and observation under microscopes. But the machines that produce the blocks cost upwards of $25,000. Most universities can only afford a few, forcing researchers to jockey for time with them. Current machines also stamp out the blocks with the tissue embedded horizontally. Researchers, however, need tissue aligned vertically, so it can be sliced thinner and produce a greater number of samples for analysis. As a result, each block has to be rotated 90 degrees manually, a tedious additional step when dealing with numerous blocks that can also introduce contaminants.

During spring 2010, an undergrad mechanical engineering team took up the challenge of developing a cheaper, hand-held tool. The students produced a device the size and shape of a Sharpie pen. "It stamps out the block and also rotates it by 90 degrees," team member Mario Miranda proudly explains. "You never have to touch the block." DPC has found a sponsor to develop the tool further, and is looking for a graduate student to work on it.

Part of the value of DPC comes in the real-world experience gained by students, Louie says. It's an excellent training ground because they have to "learn to communicate with MDs and DVMs to convey their ideas." Having to reach across disciplinary boundaries and manage a project that produces a product "challenges and hones their managerial skills." And, Davis adds, it gives them "another thing to talk about when they go on job interviews."

For Elsheikh, the experience shows what engineers can achieve. "We mechanical engineers boil the physical world down pretty quickly," he says. "Even if it's a surgery tool for a vet or something that goes into space or underwater, it boils down to simple principles that we like to apply to everything. I learned we're a lot more capable of doing things than we sometimes think."

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ABOVE: Mechanical engineering students adjust their canine physical therapy device while Chelsea the dog patiently waits.