AguaClara RIDE (Research, Invent, Design, Engage) Program

Monroe Weber-Shirk, Senior Lecturer, Department of Civil and Environmental Engineering
College of Engineering

What makes this an internationalized curriculum? Please describe the experience abroad and how you internationalized the curriculum at home.

Fall preparation course, January 2 weeks in Honduras, spring reflection and final projects. The Honduras trip is an intensive immersion in the full context that enables (or disables) the engineering work of AguaClara.

1. How has the international experience been integrated into the curriculum?
   I created CEE 4560 (Fall) and CEE 4561 (Spring) two years ago so that for the first time students could receive credit for the Honduras trip.

2. What are the intended student learning outcomes of the internationalized curriculum related to knowledge generation, changed attitudes, and developed skills, and how do you assess them? (I’m not an expert on this one and I feel that what I have to contribute has more to do with how to design a program that is a win/win/win/win/win. I am convinced that by creating a context for student engagement where students perform useful work that directly contributes to making the world a better place that the learning outcomes will almost automatically improve over traditional focus on prior knowledge.)

The AguaClara program at Cornell University has developed an innovation system with a focus on community scale water treatment technologies. Students and faculty Research, Invent, and Design sustainable water treatment technologies and Engage (RIDE) with partner organizations who Design/Build/Operate/Train and Transfer the facilities to communities. The innovation system could be adapted to additional global challenges to rapidly and systematically develop improved solutions.

The AguaClara RIDE is based on several key insights.

- **It is a short walk to the edge of knowledge.** Surface water treatment technologies as used by municipalities in the global north are in a very early stage of technology development and are far from optimized. This insight is based on the observation that water treatment plant designs are highly variable and based largely on empirical design guidelines.

- **Useful is a high standard.** The goal of developing useful solutions is a very high standard and requires a long term commitment and focus. Traditional 3 year project funding cycles are not sufficient to develop, test, and refine new technologies.

- **Invention is a creative and complex process.** Inventions benefit from a network that provides diverse perspectives. Clear identification of the problem and the critical design constraints guides the invention process. Inventing new geometries requires creative exploration of alternatives. A high performing invention team requires a safe place where mistakes are accepted and breaking through conventional wisdom is encouraged.
- **Open source engineering encourages idea sex.** The innovation cycle is simplified and accelerated by having all partners share in the idea generation with assurance that all ideas will be shared openly.

- **Innovative is a hard sell when building infrastructure.** Communities and to some extent partner organizations want a solution that works and are less concerned about an optimized solution. Historically the focus on proven technologies has led to stagnation in the evolution of water treatment technologies. The planet needs an optimized solution to reduce the resources required for water treatment. A long term commitment to continue to develop better solutions to a global problem makes it possible to achieve sufficient expertise to make dramatic improvements.

- **Inventions are based on the need to solve specific problems.** Those problems are identified primarily from two sources: first, a physics and fabrication based understanding of potential performance improvements and cost reduction and second from observing failures and operating challenges that show up in the water treatment facilities.

- **Smart hydraulics provide simplicity on the other side of complexity.** Advanced hydraulic controls can eliminate the need for use of unreliable “high tech” electronic and mechanized components.

The innovation system has been implemented in a curriculum that was crafted to facilitate peer-based learning and a project-based course sequence for **knowledge generation**, a theory course for **knowledge synthesis** and multiple modes of **knowledge exchange** between the university team and implementation partners. The innovation system is designed to maximize distributed intelligence and to reduce dependency on the leadership team. The ability of the AguaClara team to continue to reduce costs, invent new treatment processes, and enhance performance suggests that this innovation system approach could be adapted to solve other global challenges. The knowledge generation and exchange are based on long term international collaboration. That collaboration is enhanced by the annual 2 week engineering-in-context trip to Honduras. That trip provides an opportunity for students to share what they are learning with our partners in Honduras and for students to learn the rich context of social, political, environmental interactions that are required for successful infrastructure programs.