Community Based Engineering Education: An Evolution Toward Long-Term Partnerships

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Abstract

This hydraulic design course provides students with the opportunity to partner with local organizations in working toward long-term solutions to community challenges. Most design projects are limited in scope to problems that can be solved over the course of a semester. By teaming with community partners such as a local village or science museum for multiple years, more complex problems can be addressed. From this multi-year approach students receive a deeper appreciation for the importance of client relations, the complexity of engineering designs, and the role of engineers in the community. This innovation is an example of project based learning.

Introduction and Objectives

Hydraulic Design is a required junior level civil engineering lecture and lab. The class meets six hours per week.

Educational Objectives :

- Demonstrate a comprehension of the design process
- Apply that process using hydraulic engineering principles to a project in their local community
- Extend the process using material from previous and coincident engineering courses
- Professionally engage community leaders using both written and verbal communication skills.

Community Objectives:

- Promote civic-mindedness in the students
- Contribute to the revitalization of our local community

Developmental History of Innovation

This course has been offered three times; each time the course has experienced substantial revision. The number of projects has been reduced while the number of students in each team has been increased. Further the class is now strongly design based, emphasizing team, community, and active learning skills. This year the community partnership will expand into the prerequisite fluid mechanics course. The students will work with their clients to develop a Request for Proposal. This process of framing an appropriately scaled question will allow the students to expand their understanding of the design process while closing the loop with brainstormed ideas from the previous year.

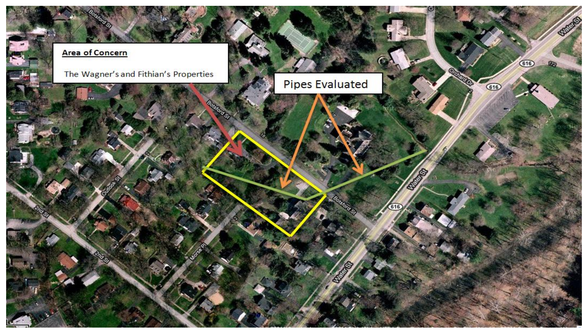
Learning Activities and Materials

What has not worked: Eight lecture driven projects per semester that were restricted in scope.

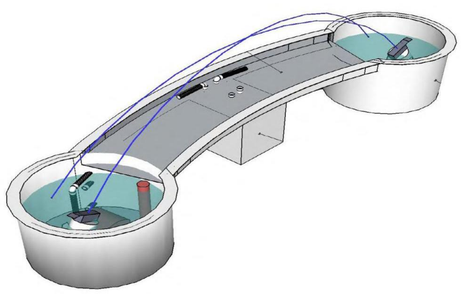
An example that did not work: Rip rap design downstream from a local culvert. Not only did the client give most of the needed information to the students in order to provide them with enough time to produce a design, but the project was so narrowly focused that in-class lectures were sufficient for the design. Further, by the time the data were gathered by the client he had already produced the simple design, making the project's true usefulness to the community marginal.

What has worked: Useful projects with committed clients and an emphasis on student-directed learning.

An example that did work: Poland Village Storm water Utility. We have now teamed for two years and look forward to working with them in future years. The first year the students were asked to map the storm water network. Students surveyed the manholes and digitized hand-sketched pipe networks into GIS and CAD programs. The second year students took this information and redesigned a section of the storm sewer network to reduce flooding in one neighborhood.



A second example that did work: OHWOW! Children's Museum opened last spring. Two of the new museum exhibits are water exhibits (jets and a simulated estuary) but don't have water treatment systems associated with them. The students evaluated a number of options, eventually designing a copper ion treatment system that will become an educational exhibit in itself while also saving the museum approximately $2,000 per year.



Execution

Students have three one hour lecture periods and one three hour lab period per week. The course execution has evolved over time to provide a greater number of project based learning activities. It is now approximately ¾ team-directed learning and ¼ formal lectures that touch on advanced topics in hydraulics and hydrology. As the semester unfolds topics such as the design process and information gathering techniques are introduced. A draft report and oral presentation are submitted to the client before spring break. Upon return, the students receive feedback from the client and revise their designs. This mid-term progress update is worth the same as the final report and presentation in order to emphasize the equal importance of the design creation and iteration/revision processes. In the project teams each student fills one of five roles: client contact, designer, writer, figures maker, or cross-over. These five roles are intended to explicitly model some of the various roles that an engineer performs in a given project. Mid-semester the students switch roles in order to provide each with the opportunity to demonstrate both technical and client-oriented skills. Student teams present their final designs to their clients during the first half of the final exam period. The second half of the final exam period is devoted to brainstorming project impacts and future steps.

Major Issues to Resolve

Expanding the course

- Fluid Mechanics
- Departmental curriculum
- STEM-wide
- University Wide

Short and long-term retention

What material is appropriate

- How much non-technical material
- Local politics
- Marketing

Liability

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Discussion

Community based engineering education is an excellent tool for engaging students, presenting material, and working with our local community.

That said, strong dedicated clients, and long-term projects appear to be important components to success.

Engaging strong clients in long-term projects better mirrors most consultant-client relationships while allowing students to be a part of much more substantial projects. A further goal of these multi-year projects is to increase our connection with our young alumni network. By creating projects that last multiple years we may be able to better entice recent alumni to lend their expertise and time toward current student learning.

Acknowledgments/Previous Clients

Eiselstein LLC
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Grow Youngstown
OHWOW! Children's Museum
Poland Village
Youngstown Neighborhood Development Corporation
YSU Facilities
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