

## **Go With the Flow - A Student Leadership Opportunity Integrating K-12 Outreach, the Society of Women Engineers, Service Learning and Peer Mentoring**

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### **Abstract**

This paper describes a multi-year project that involved the Humboldt State University Student Section of the Society of Women Engineers in a Service Learning project that now serves as a continuous outreach project to young children in the community. The SWE club oversaw the design, construction and use of a child sized flume for study of water physics that is now on display at a local children's science museum. Students in 3 different engineering classes that were offered repeatedly over 5 semesters were directly impacted by the project. Engineering students in a fluid mechanics class designed the flume via a SWE supported design competition. The SWE club then raised funds for the construction of the flume, which was built by the engineering department technician. The project was integrated into two other engineering courses in such a manner that senior engineering students worked with first year students as part of the same project. SWE members as well as other engineering students then took the flume to local schools and outreach events. The SWE students experienced fund raising, project management, and teaching K-12<sup>th</sup> grade physical science concepts. K-12<sup>th</sup> grade students were exposed to female engineering role models. Over 150 engineering students, as well as 3 engineering faculty were involved in the project in some capacity. 750 local children were exposed to the flume during SWE outreach activities. This project model could be used in other fields of engineering. This project incorporates K-12 outreach, Service Learning, peer mentoring and extracurricular service.

### **Project Overview**

In the fall of 1998, the Society of Women Engineers at Humboldt State University requested that the fluids mechanics class design a flume exhibit for the Redwood Discovery Museum, a local children's science museum. Three of the 15 designs submitted best fulfilled the requirements. A composite of the three designs was developed and built, using funds raised from local businesses and a Society of Women Engineers Program Development Grant sponsored by the ExxonMobil Education Foundation. The flume was completed in the fall of 2000. In the academic years of 2000-2002, engineering students in freshman and senior design courses designed and built inserts for the flume as well as develop interpretive materials. During the 2000-2001 academic year, over 750 local children were exposed to the flume via SWE outreach activities. Over 150 engineering students were involved with this project as well as 3 engineering faculty. The flume is housed at the Redwood Discovery Museum, where museum visitors continually use it and learn how environmental engineers use flumes to study rivers and water physics. The flume is available for outreach visits to local schools. This paper focuses on the leadership opportunities this project provided for the Society of Women Engineers students. Another paper has described how this project was integrated into both freshman and senior design courses<sup>1</sup>.

### **Society of Women Engineers at Humboldt State University**

The Student Section at HSU received their official charter in December 1997 with approximately 15 members. Environmental Resources Engineering, with approximately 200 majors (25% women) is the only engineering program at HSU, so all SWE students are ERE students. SWE at HSU received Best New Student Section of 1999. Over the past 5 years, the membership has varied between 10 and 20 students.

In the spring of 1998, the new section decided to sponsor a flume exhibit to use for student outreach visits and to donate to the local children's science museum – The Redwood Discovery Museum. The project was modeled on a similar project developed by engineering students at Cornell for the Ithaca ScienCenter.

### **Design Competition**

The SWE President worked with the fluid mechanics professor to organize a student design competition in the fluid mechanics class, using the Redwood Discovery Museum director, as the client. Forty students on 10 teams participated in the design competition. This course had not previously included a design project. The fluids students reported that they enjoyed having a design project that would actually be implemented and used by children to learn more about engineering. The competition judges, overseen by SWE, selected three designs to be combined into a final design.

### **Fund Raising Efforts**

In the spring of 1999, the SWE section began to raise \$3000 to complete the design. The students organized a phone and letter campaign to women's organizations, local businesses and to ERE alumni. In addition, they submitted a proposal to the Society of Women Engineers Program Development Grant sponsored by ExxonMobil. However, the first proposal was never received, so in the spring of 2000, a new set of student SWE leaders submitted an updated proposal that included a request for funding to complete the building of the flume. The second proposal also included funds for the development of physical inserts designed and built by senior hydraulics students for studying the change in water flow around devices such as bridges and weirs. The funded proposal requested \$3300 and included a K-12 outreach plan, the development of web based interpretive materials, and promised over 300 hours of volunteer time.

### **Design Implementation and Flume Description**

The Environmental Resources Engineering department donated the time of the department Equipment Technician. SWE students and the SWE Advisor completed significant negotiations with the technician so appropriate materials were obtained. In the end, a total of 3 college technicians worked closely to develop and implement a final design that incorporated the designs selected by the judges in the fall of 1999. A significant effort on the part of SWE students to complete a large number of negotiations with the 3 technicians as well as make arrangements with local suppliers for the raw materials.

The flume was completed in the fall of 2000 and is 8 feet long and 3 feet wide, consisting of a Plexiglas tank, aluminum siding, and a steel base that serves as the reservoir. Unfilled, the flume weighs approximately 250 pounds and fits in the bed of a large pickup truck. When filled, 100

gallons of water is circulated with a 1.0 HP pump. A single sheet of Plexiglas is used to separate two six-inch wide channels as shown in Figure 1. Children can adjust the slope of the channels using a hand air jack. They can control the flow rate of each channel by opening or closing the sluice gates at the headworks. Students adjust the outflow rate using chains on hinged doors at the tailgate.

### Service Learning and Peer Mentoring

As mentioned above, a detailed presentation of the Service Learning and peer mentoring activities incorporated in the flume are described in<sup>1</sup>. A summary of this aspect of the project is provided here.

Students in the fall 1998 fluid mechanics course developed the original flume designs for the Redwood Discovery Museum. Two other courses were involved with the project, with the HSU Student Section of the Society of Women Engineers as the client. One course was the senior level applied hydraulics course, while the second course was the first year introduction to design course. Students in these two courses worked together to provide physical inserts and interpretive materials for the flume.



**Figure 1 Humboldt State University Society of Women Engineers Flume with view from tailgate looking toward the headworks.**

Most of the leadership of this aspect of the project was provided by the SWE advisor and ERE faculty member, Dr. Beth Eschenbach and ERE faculty member, Dr. Eileen Cashman. Drs. Eschenbach and Cashman taught the courses involved and needed to coordinate closely so the over 50 students involved in the design classes activity would have a productive experience. Over two semesters, seniors in the applied hydraulics course or river hydraulics course designed, built and tested inserts (e.g. bridges, weirs and velocity meters) to be used by children in the flume. Figure 1 shows two different bridge inserts as well as velocity meters (a rubber duck, ping pong balls and the pinwheel in the boy's hand).

The first year students in the introduction to design course met periodically with the seniors in the hydraulics courses to develop web based interpretive materials to go with each insert. These materials included at least one diagram. These materials were used by the Redwood Discovery Museum to develop a fixed interpretive display. The web pages are also used for students taking the flume on outreach visits. These web based materials can be found at<sup>2</sup>.

The process of requiring the seniors and first year students to work together on a project for the Society of Women Engineers provided an opportunity for informal advising and peer mentoring among the ERE students. First year students became more aware of the requirements of the

major. The more senior students enjoyed working with the first year students and “showing the them the ropes” in the context of a class required activity.

An interesting phenomenon occurred during this phase of the project. For the introductory engineering course, the flume would be introduced by the female SWE officers to a lab of about 24 students. Invariably, the first students that would walk forward to interact with the flume were female students. The men would take longer to decide to engage with the equipment. The role models of women engineering students being confident and comfortable with a large piece of equipment seemed to make the first year female engineering students comfortable as well.

### **K-12 Outreach Activities**

As part of the grant requirement, HSU SWE made eight outreach visits with the flume during the 2000-2001 academic year. The SWE President Vice President insured the success of this portion of the project. Over the course of the year, the flume was taken to the local indoor shopping mall; two middle schools; one high school; the elementary school for the Hoopa Native American reservation; the high school and community college career fair; a workshop for junior high school girls; a SWE organized ice cream social for science fair attendees and lastly, the flume was presented to the Redwood Discovery Museum. Over 750 children interacted with the flume during this year. All of these outreach visits were led by HSU SWE members, however most were attended by non SWE members as well. A video summarizing these outreach visits, as well the flume project is available<sup>2</sup>.

### **Presentation to Funders**

The SWE leaders were invited to present the results of their project at the SWE National meeting. Funds were raised on and off campus to cover their travel costs. The students, working with the campus videographer, prepared a video<sup>2</sup>, as well as a PowerPoint presentation outlining the major outcomes of the project. Three students attended the meeting and came back changed women. Their presentation was very successful and their exposure to women engineers in a national setting provided them much perspective on their own educations. They returned very proud of their accomplishments and of the environmental resource engineering program at Humboldt State University.

### **Summary and Conclusions**

This project spanned over 4 years and 4 generations of SWE officers and the impacts of the project are ongoing. Between the outreach activities and the Service Learning activities over 150 engineering students were involved in the project. Approximately 100 of these students were



**Figure 2 Girls enjoy flume at SWE sponsored ice cream social for female**

involved with the project via a course required project. This project was integrated into the curriculum of 3 different engineering courses that were offered repeatedly over 5 semesters. In the outreach year over 750 children in the HSU area were active with the flume. The flume resides at the Redwood Discovery Museum. This very popular exhibit is only display that has not required significant overhaul and is available for SWE outreach activities.

The student leaders of this project gained valuable experience and satisfaction. They learned about organizing people, fund raising, proposal writing, project and people management, working with clients, organizing and outreach program and presenting to a funding entity.

The Humboldt State University SWE student section, as well as the environmental resources engineering department gained much visibility. Many engineering students benefited from the hands-on involvement in the project. Lastly, many children continue to be inspired to be environmental engineers and have fun with water physics at the Redwood Discovery Museum.

The authors hope that this project description will inspire others to consider their engineering disciplines and organize similar projects that integrate student leadership opportunities, K-12 outreach, Service Learning and peer mentoring. By integrating a student initiated project into the engineering curriculum, all students become more empowered.

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### **References**

<sup>1</sup> Eileen M. Cashman, Elizabeth A. Eschenbach, Lynn McIndoo, Sangam Tiwari, Jayne Nordstrom, and Jillian Gayheart (2001) Go with the Flow: A Design Project to Build Community, Proceedings of the Frontiers in Education Conference, Online <http://fie.engrng.pitt.edu/fie2001/papers/1372.pdf>, viewed January 11, 2004.

<sup>2</sup> Humboldt State University Society of Women Engineers (2002) Projects, Online: <http://www.humboldt.edu/~swe/projects/projects.html>, viewed March 13, 2004.

### **Biographical Information**

Elizabeth A. Eschenbach is an associate professor and department chair of the Environmental Resources Engineering Department at Humboldt State University. She was the SWE faculty advisor from 1997 – 2002. She teaches introductory engineering courses and upper division courses in probability, environmental impact assessment and water resources. Dr. Eschenbach is a member of ASEE and Faculty 21 in Project Kaleidoscope.

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