CROSSING DISCIPLINARY BOUNDARIES: OPPORTUNITIES FOR UNDERGRADUATE RESEARCH AND FUN FOR FACULTY

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ABSTRACT:
Crossing traditional disciplinary boundaries is both a good way to engage undergraduates in meaningful research experiences and provide faculty with opportunities to collaborate with colleagues across their campus, including those in the arts, humanities, social sciences, and technical disciplines. Moving beyond traditional disciplinary boundaries often requires us to broaden our definition of research, particularly as it applies to the range of problems that can be explored by undergraduates. This presentation provides examples of research projects undertaken by students that cross disciplinary boundaries including collaborations with faculty colleagues in technology, social sciences, and the arts. Strategies for initiating collaborations, identifying potential projects, and other challenges encountered in crossing traditional disciplinary boundaries are highlighted.

Defining Research: Broader is Better
Definitions may vary, but faculty generally agree that undergraduate research is a student-faculty collaboration to examine, create and share new knowledge or works in ways consistent with practices in the discipline. Undergraduate research projects can be initiated in at least two ways:
1) By the student with faculty supervision; and
2) By the faculty researcher while involving the student as an individual or member of a team. The key is that the undergraduate research project engages students in original research, analysis, conclusions, and dissemination.

Ways to Initiate Collaborations:
1) Find ways to meet your colleagues—serving on campus-wide committees and leaving your building to get coffee/eat are both great ways to meet potential collaborators.
2) Talk about your interest in doing collaborative research projects with those that will listen. You never know when a connection will be made.
3) Actively seek out your colleagues in other departments that are doing interesting things with students and/or have expertise in areas that complement your interests.

Collaborations with Technology Faculty and Students:
Two collaborative projects brought together six students and three faculty from the Earth Sciences and Technology Departments. The students were enrolled in ENT422, Machine Design II, a design course in the Buffalo State Mechanical Engineering Technology program and the projects were a course requirement. In the first project, a 16 foot-long wave tank was built. The second project involved rebuilding a 20 foot-long recirculating flume. The-long wave tank was replaced was over ten years old and had developed numerous leaks. In the design phase of both projects, the students evaluated construction materials, construction cost, maintenance, and performed a stress analyses for each design option considered. Today, both the wave tank and flume are used to support a variety of demonstrations in courses including GEES 300, Sedimentology, GEES 315, Marine Environments, and GEES 224, Geological Hazards. One of the student's favorite demonstrations involves pouring gallons of milk down the flume to model turbulence currents. These two successful collaborations resulted in the design and construction of demonstration equipment for geoscience courses that would otherwise have been financially prohibitive. The six students were especially excited to think that the wave tank and flume they built will be used for years to come.

Details of Recirculating Flume:
The original flume was built in 1987 by two undergraduates. Water recirculated through the 20' long flume and velocities were controlled by two butterfly valves connected to PVC pipes and the 7.5 hp pump. Over the years, leaks developed between the joined sections of Plexiglas, but other than the leaks, the operation of the flume was trouble-free. Rather than start again, it made more sense to rebuild the flume. This opportunity also allowed us to make some minor design changes as well. Largely based on the success of the collaborative effort that resulted in the wave tank, the rebuilding of the flume was undertaken by three students enrolled in the capstone engineering course.

The students removed the Plexiglas and most of the old piping. The support platform was then modified to accommodate the slightly modified new tank, frame, and piping (see figure). A new valve mechanism was also installed to facilitate draining and cleaning of the flume.

Details of the Wave Tank:
Design and Materials: The tank is 16' long, 3'10" high, and 4' wide (see figure). The tank walls are 1" Plexiglas and are supported within a welded and powder coated steel frame. The frame is supported on 1" plywood resting on a stand. Adjustable feet on the stand allow the frame and tank to be leveled on the floor. The Plexiglas is bolted into place with stainless steel retaining rings. The retaining ring is sealed to the flume with 1/8" rubber gasket. A rubber O-ring was used to seal the steel frame. One of the benefits of this unusual and unique design is that the wave tank can be repaired and/or lengthened without breaking a permanent plastic bond because each wall of the tank can be removed by unbolting the section. The materials for the wave tank were less than $3000.

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Faculty Collaborators: David Kukulka and Jim Shea, Technology Department
Student Researchers: Bill Hughes, Ken Miller, Scott Mall, Tim Conestable, Tim Braymiller, and Dave Rabideau
Collaborations with Colleagues in Other Departments:

Buffalo State College received NCUR/Lancy funding in 2000 and 2001. The central theme of the interdisciplinary collaborative research focused on environmental and social changes in Buffalo over the past century. Buffalo’s celebration of the centennial of the 1901 Pan-American Exposition made this research focus especially timely and also took advantage of the College’s proximity to the exposition grounds (across the street) and easy access to the ethnically diverse neighborhoods and public health projects undertaken by students and faculty. The faculty mentors represented four academic departments: history, sociology, earth sciences, and performing arts. The program ran approximately nine weeks and for both years we divided the summer program into three parts.

The first part included a number of activities designed to acquaint the students with the city’s architectural treasures and its environmental, historical, sociological, and geographical context. Assigned readings and discussions focused the students’ attention on key events and provided the background necessary for the students to appreciate the city’s current environmental and social changes. During this part of the program the students also became familiar with the resources available within the community, including “scrapbooks” of newspaper clippings available at the Buffalo and Erie County Public Library and the extensive photographic collection held by the Erie County Historical Society. During the middle portion of the program, the students conducted their research projects. Weekly meetings during this phase of the program ensured that the group maintained close contact. The final part of the program was devoted to the construction of the display on which the students’ research findings were displayed. The group worked together to construct the plywood flats that were hinged together and painted with various scenes (Figures below). This portion of the project relied on the talents of Professor Carol Backley, Performing Arts Department, and gave the entire group lessons on “tricks of the trade” from set design. The creation of the flats required a high level of interaction among all members of the group and required the students to not only consider what they wanted to say, but also how they wanted to illustrate their particular topic in a visually engaging way. The students presented their research during the NCUR 2001 and NCUR 2002 conferences and their displays were on exhibit at the Buffalo State Library for several months.

Examples of Projects Undertaken by the Students

- Study of the effects of water diversion on the Niagara River
- Study of the construction of the Buffalo Harbor and waterfront
- Study of how transportation (transition from canal to rail to expressway) contributed to changes in Buffalo’s neighborhoods
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- Study of changes in the urban landscape, particularly in the number, distribution, and diversity of trees within the City
- Examination of public health issues and how these factors impacted the quality and quantity of fish in the Niagara River
- Study of how transportation (transition from canal to rail to expressway) contributed to changes in Buffalo’s neighborhoods
- Study of the construction of the Buffalo Harbor and waterfront including physical changes to the harbor, construction of breakwaters, and the environmental consequences of more than a century of development and modification
- Study of the effects of water diversion on the Niagara River and the American Falls and visa on its impact on preserving or destroying the scenic integrity of “the Falls”
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Collaborations with Colleagues at Other Institutions:

Working with Patricia Manley, Middlebury College, changes in the bottom morphology of the Buffalo River have been documented. Our approach has involved the use of side-scan sonar and comparison of surveys from year-to-year. This multi-year effort has resulted in three senior theses (Middlebury College; L. Fuller, 1992, shown right), several research projects (Buffalo State College), and several presentations. Students have identified areas of sedimentation and deposition and have documented slumping following removal of sediment by maintenance dredging.

A particularly interesting feature discovered through side-scan sonar mapping is the sedimentary furrow (left, Monninger, 1998). Furrows are longitudinal bedforms that have been identified in a number of diverse sedimentary environments including the deep sea, estuaries, and large lakes. Their origin has been attributed to secondary circulation in the bottom boundary layer. The furrows in the Buffalo River persist from year-to-year along a 1000 m section of the river (right, Monninger, 1998). Biannual to annual surveys within this field reveal changes in the convergence and divergence of individual furrows, as well as the addition of new furrows and disappearance of others. Research projects undertaken by students include characterization of furrow morphology and annual changes in appearance and number.