Experiences of Engineering Students in post-Katrina Service Learning Programs

Denise Wilson
Department of Electrical Engineering, University of Washington, Seattle, WA, USA
Contact: denisew@u.washington.edu

Abstract - This paper discusses two case studies of engineering student experiences in a 10-week fully integrated academic/service learning program on the Gulf Coast of Mississippi in the Hurricane Katrina Recovery effort. The program delivered in the Winter of 2007 combines a service learning component oriented to hands-on reconstruction of a Gulf Coast community and a formal academic curriculum that emphasizes a bird’s eye understanding of the Hurricane Katrina Story, from a perspective of the technology that helps and hinders natural disaster recovery. The pilot program was a full load (12 quarter credits) program that placed 12 students from a major Northwest university on the Gulf Coast for an entire term. The case studies of two engineering students presented herein demonstrate a level of advanced performance (as compared to campus-based learning) that has been often suggested but rarely documented in the literature. Improvements in affective measures (such as belonging) and academic outcomes (such as demonstrated understanding of broader impacts in persuasive writing) are significant for both students, despite the significant differences between them.

Index Terms -- Service learning, Hurricane Katrina.

CRITICAL NEED

Katrina-inflicted damage on the Mississippi coast remains severe and many, many residents continue to live in trailers or improvised accommodations while searching for means to rebuild their homes. In the second year (2007) of a 15-20 year recovery effort, the need for semi-skilled and skilled labor was extraordinarily high and far outpaced the need for unskilled labor. This need, while part of a larger tragedy in Katrina's wake, provided a wonderful opportunity for students to truly make a difference and have an impact on society by rebuilding homes along the Gulf Coast of Katrina-impacted Mississippi.

PROGRAM SUMMARY

The Gulf Coast program offered, to all majors, an integrated service/academic learning opportunity in the context of the Hurricane Katrina aftermath and recovery. In the Winter Quarter of 2007, a complete program of service learning and traditional academic instruction was offered to a class of students from a major Northwest university. In study abroad style, these students participated in a 10-week (quarter long) service learning program on the Gulf Coast in conjunction with a group of students from a smaller minority institution in Mississippi who took a parallel academic course and participated in one week of service, side-by-side with the students from the Northwest. All service activities were completed in Bay St. Louis (BSL) and neighboring communities along the Gulf Coast of Mississippi, where Hurricane Katrina had her most devastating impact. Students from all areas of study (4 from engineering) participated in the combined curriculum of (a) 6 credits of service learning internship; (b) 5 credits of engineering coursework (Engr498a) in a new offering entitled, “The Impact of Katrina on Technology and Infrastructure” and (c) 1 credit of Engr499a, Service Learning seminar. The local (Mississippi institution) students enrolled in an equivalent course to Engr498a on their home campus (four hours north of the Gulf Coast) and obtained service learning credit for graduation.

The addition of Engr498a to the service learning component of the program addressed the higher level analyses of natural disaster leadership, response, and recovery in the context of Hurricane Katrina and technology infrastructure. Integrating this formal academic course with service learning in a domestic study abroad experience provided the student with a simultaneous immersion in service and an intensive application of technology and engineering concepts to a timely situation of national relevance.

The Gulf Coast service program [1] emphasized the integration of academic attention to the Hurricane Katrina story, such as the comprehensive lecture series provided by Tulane University on The Storm [2] with meaningful service outreach efforts to the Katrina Recovery such as those conducted by Rowan University [3], the University of Washington Honors Program [4], and others.

The service learning component of the program (3.5 days per week for 10 weeks for U/W students) involved serving within an existing relief facility on the ground in Bay St. Louis (First Presbyterian Church Katrina Recovery program). Students participated in a broad range of jobs including formal rebuild assignments from the relief facility, alternative outreach to local schools, and individually initiated tasks. Rebuild assignments began at low skill level with jobs such as gutting, painting, and yard clean-up. As students acquired skills from on-site contractors and hands-on experience, they moved on to

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more skilled, minimally supervised jobs including sheet rock installation, plumbing, wiring, and tiling. Students also visited the local displaced elementary school on a weekly basis to support science fair preparation and general classroom work. Science activities completed for a variety of K-5 classes include a combination of traditional activities (static electricity, gravity, etc.) and Katrina-related activities (hurricane proof home construction, wetlands storm surge protection, etc.).

The academic portion of the program, bounded by the 5 credit course Engr498a is a formal engineering-based academic course that seeks to understand the broader power struggles, politics, and cultural influences that limit or extend the use of technology to the betterment of society. Topics in this course included levee failure in New Orleans, wetland degradation in Louisiana and around the world, the impact of river and canal control structures on environmental integrity, communications technology, power grid stability, and others. The complete course materials are available at the website in [1]. Course assignments (for the 5 credit offering of Engr498a in Winter Quarter of 2007) include weekly reflections on the readings, a term paper examining a topic of choice related to Hurricane Katrina Rebuild and Recovery, and an electronic portfolio containing relevant artifacts from the service learning program.

**Program Framework**

In addition to integrating an academic and community service perspective on the Hurricane Katrina Recovery, the Gulf Coast service learning program also sought to model, in the higher education arena, the learning environment developed by Campion and Brown [4] for K-12 (called Community of Learners). Many of the benefits of the Community of Learners were also demonstrated in the Gulf Coast program: improved academic outcomes, higher belonging/sense of community, more positive affect, and increased depth of expression.

The Community of Learners model is characterized by six major principles of facilitated instruction. The first, Community of Practice, was inherent to the Gulf Coast program purpose. In a Community of Practice (as defined within the Community of Learners model), students form interdependent relationships with members of the community so that learning not only benefits but requires active interaction with those members. Interdependence was intentionally woven into all four major aspects of the Gulf Coast program:

- **(Service)** In the service aspect of their experience, students specialized in different skills (sheet rock installation, flooring, job management, etc.) in the rebuilding of residential homes and communities along the Gulf Coast. On any given day, the student crew was dispersed in teams to a number of different homes or public works projects. In order to have a successful experience, students self-assembled their expertise and working styles into effective work teams that depended on individual skills to complete complex contracting jobs.
- **(Academic)** The range of technologies covered in the academic portion of the program was so broad that week-to-week, leadership (in knowledge and perspective) was taken on naturally by different students whose background training best matched the technology at hand. For example, in one week, a discussion of power systems and power grid technologies placed the single electrical engineering student in the leadership role for supporting writing of the weekly reflection. The next week, a discussion of levee and flood control structure technologies placed the two civil engineering students in a natural leadership role. The next week, an emphasis on environmental pollution incurred by Hurricane Katrina placed the environmental sciences student at the head of the group, and so on.
- **(Personal)** Because of limited access to resources, students self-organized into divisions of labor for basic household tasks (shopping, laundry, cooking, cleaning, etc.). For example, weekly combined laundry/shopping trips and limited transportation necessitated that some students “oversee” laundry while others shopped for both themselves and for those left behind to monitor loads in the laundromat dungeon.
- **(Professional Development)** Students had ready access, through community engineering projects and field trips, to a variety of professionals at work in the rebuild and recovery process. To successfully complete term papers and define professional (career goals) for the portfolio portion of Engr498a, students sought out these professionals to complement and enhance their academic assignments.

In addition to the dominating and intentional effect of the Community of Practice element of the Gulf Coast program, other principles of Community of Learners were interwoven into the experience as well. Some principles of the Community of Learners evolved as a consequence of circumstance (the Hurricane Katrina recovery). For example, an interactive discussion and team-based assignment element was designed into the academic component of the program (Engr498a) to support a dialogic base. However, close living conditions and study quarters promoted this dialogic base well above and beyond the contributions of 1-2 hours of facilitated, weekly discussion in class. Circumstance (on the job training for residential home rebuilding) supported learning far more as an active learning than a passive process while intentional design of (inherently active) field trips supported this same principle. By self-selection, student participants in the program came from a wide range of majors and backgrounds (from engineering to law/social justice). Such diversity in the student population (by design) in conjunction with close interdependence in the living situation promoted a legitimization of differences (acceptance of others on the team) well beyond that typically experienced in the classroom.
environment. The Gulf Coast program also provided (by circumstance and by curriculum design) a range of opportunities to explore engineering in a broad range of cultural, social, and political struggles present and evident in the Hurricane Katrina aftermath. The intense diversity of learning opportunities naturally supported multiple zones of proximal development, to provide students best opportunities to grow in individual intellectual development. Finally, the last principle in the Community of Learners Framework, that of developmental sensitivity, was honored by the individualized nature of each term paper and by the highly heterogeneous composition of courses of study represented by the program participants. Students chose term paper topics, approach, scope, and perspective to match their interests and stages of growth. Papers completed by freshman were graded using a different rubric than those completed by seniors, both to provide fairness in grading and also to enable students to grow from their own individual points of departure. From the instructor as well as from peers, all levels of knowledge and understanding were respected and accommodated, in part because of the freshman-graduate range of expertise represented in the course, but also because the surrounding community (natural disaster recovery) promoted sensitivity to others (in the community) at highly individualized (and varied) stages of recovery.

**METHODS**

Surveys, focus groups, and classroom observations were used to assess the nature of and academic/affective outcomes of the Gulf Coast service learning program. The survey consisted of a combination of demographic items, affective items that may influence or confound sense of belonging, items that assess local sense of community (classroom, department, college, university), and items related to affiliation with the global workforce.

Items that directly assess belonging at local level (class, department, university) were validated in previous studies (Anderson-Butcher & Conroy, 2002). While the survey instruments provided a starting point for understanding potential changes in sense of community that occur through the Gulf Coast program, they did provide a means for identifying how these changes are occurring and subsequently, how they may be improved in future offerings of the course. Interpretive research provided the “specific structure of occurrences” ([6], p. 121) that complement the general, overall distribution of community data in the program as extracted by the survey instruments. Knowing specific structures allowed us to understand what happens in the particular classroom formed via the Gulf Coast program; interpretive methods also provide important complements to general survey-based observations ([6], p. 121):

- the “meaning-perspectives of the particular actors in the particular events”: what, specifically in classroom activity, affects perceived belonging, connection to community, and other affective measures in the classroom and larger community?

- the “location of naturally occurring points of contrast that can be observed as natural experiments”

Additional means for understanding student experience in the Gulf Coast program were provided via (i) focus groups that explore student’s reasons for pursuing the major, obstacles in doing so, and perceptions of fulfillment and belonging; (ii) observations of student engagement in the community; and (iii) academic performance, both quantitative and qualitative. Using both survey and the more qualitative data provided by these additional tools, case studies framed around the experiences of two of the engineering students in the program are presented. The two studies presented herein describe engineering students with very different backgrounds, but who present a common theme of thriving in a program that is immersed in the community impacted by the technologies studied.

**CASE STUDIES**

**Bethany, the female minority engineering student**

Bethany is a minority female student with an average undergraduate GPA (3.0). Neither of her parents attended college, yet she has ambitions to attend graduate school in engineering. She often feels overwhelmed in her engineering classes, but remains intrigued with course topics. She feels capable, but limited in her ability to apply the skills learned in her undergraduate engineering experience. Compared to the start of her curriculum, she has modified her study habits most significantly by asking questions in close proximity to gaining access to relevant material. She asks questions “right away” rather than waiting for a crisis point (exam, assignment deadline) in her courses.

Bethany’s sense of belonging compared to her peers in engineering at the University of Washington is low (On a 5 point Likert scale: 2.6 vs. and average 4.06 in control group of students enrolled in a traditional engineering class). She views belonging as “fitting in” with her peer and professional group and sees belonging as a critical piece in determining fulfillment. In her undergraduate engineering career, she confesses that she doesn’t think about her fulfillment and is unable to identify it when asked. Her experiences in relationship with other people at her home institution (in the Northwest) are best for her peers (6 on a Likert scale of 7) and worst with academic advising (2) and administrative personnel (3). Overall, Bethany expresses a lack of connection to her engineering department and home institution community: “That’s just the way it is for minority students. I’m used to it.”

During the Gulf Coast service learning program, however, Bethany shows a significant improvement in sense of belonging (3.88 in the program vs. 2.61 at the home institution). She cites significant improvements in her impressions of feeling technically competent and socially comfortable (in both areas, she expressed a 2 point increase on a 5 point Likert scale from a “2” the University of Washington to a “4” in the intervention).
Bethany also shows well above average demonstrations in the two primary outcomes of increased belonging (that are observed and assessed in this intervention); academic performance and community engagement. In all areas of her program, she is both heavily invested and highly inclined to take initiative and a leadership role, indicating overall a high level of engagement. She participates in all of the field trips and is active in asking questions of program and presentation leaders. Her follow-up writing (weekly 2-3 page reflection essays) contains components of the reading, discussion, and field trips associated with each weekly topic. Such integration of these hybrid sources of information is unusual among her peers. In her term paper, Bethany exhibits similar qualities. She completes her term paper, with little assistance from faculty, integrating information from a wide variety of sources to understand, in a balanced and realistic manner means for improving transportation systems and engineering in crisis situations. Overall, Bethany’s academic performance for the mainstream course within the intervention program is ranked #2 of 12 among her peers.

As part of an independent study component to her program, she defines a fairly difficult problem squarely within the context of serving Hurricane Katrina victims: assessing the post-Katrina toxicity of a former (Hurricane Betsy generated) landfill site occupied primarily by the disenfranchised poor in New Orleans. She is active in follow-up on testing and data collection activities, and extends herself beyond the basic, faculty guided collection of data that is often the signature of the average engineering undergraduate. She takes the initiative to understand underlying sensing technologies used to collect the data, including their limitations and capability within the context of the overall problem. She accepts delays (by outside laboratories) in data analysis, remains on task with lengthy, tedious sample extraction and processing, and follows up as data becomes available. She is quick to point out her weaknesses in the use of particular software programs yet engages the assistance of other students to resolve these weaknesses. She is not entirely successful in resolving her weaknesses, but remains engaged, regardless of these shortfalls. The only notable weakness in her engagement is her delay in wrapping up her independent study. However, relative to other engineering undergraduates enrolled in independent study, her grasp of the overall problem context and formulation, initiative, commitment, and presentation are well above average. Interestingly, Bethany remains seemingly unaware of her outstanding performance, as evidenced by the fact that she frequently apologizes for her shortfalls and delays in completing the project.

Overall, in Bethany’s case, we see substantial increases in belonging, academic performance, and academic engagement during the Gulf Coast program. From the detailed responses to the components of belonging, we know that a significant increase in technical competence and social acceptance go hand in hand with the increase.

Matthew, the caucasian male engineering student

Matthew is a majority Caucasian student with an above average undergraduate GPA (3.35). Like Bethany, neither of his parents attended college, yet he has ambitions to attend graduate school in engineering, after pursuing a non-profit track, such as that offered by the Peace Corps. Unlike Bethany, he is comfortable and very at ease on the home (Northwest University) campus in his courses and curriculum. Like Bethany, he is excited about his courses. He has changed his study habits since starting in engineering by reducing his note-taking during class and instead, listening more. He expresses a strong interest in a particular sub-area of his chosen field (civil engineering) in bridge design. He has not changed his career plans much since starting college.

Matthew’s sense of belonging compared to his peers at the home institution is close to average (On a 5 point Likert scale: 4.13 vs. an average 4.06 in control group of students enrolled in a traditional engineering class). Unlike Bethany, Matthew defines belonging independent of his community, as being comfortable with something rather than fitting in (Bethany’s response). Although Matthew reflects that he is very at ease in the classroom (his survey response), he admits that it is difficult to deal with the wide variety of distractions at his home institution while remaining in a major that often incurs stress and high workloads. His experiences in relationship with others are best for his peers (5 on a Likert scale of 7) and administrative personnel (also 5) and worst with faculty and academic advising (both a score of 4 on the same scale). Overall, Matthew remains relatively unruffled by the characteristic stress and (self-admitted) impersonal nature of the home institution community (as compared to his experience at a local community college prior to entering the mainstream university environment).

Despite Matthew’s neutral or positive impressions of his courses on the home campus, he expresses significant changes in sense of belonging during the Gulf Coast program. His overall sense of belonging rises from a score of 4.13 to 4.63 during the program, with the most significant changes occurring in his level of commitment to the community and in his impressions of support from this same community.

Matthew (like Bethany), while experiencing a greater sense of belonging in the Gulf Coast program than at the home institution, also demonstrates above average academic performance and engagement. The primary marker in Matthew’s academic performance is the substantial improvement in his writing over the course of the quarter. Unlike many engineering students, he shows significant initiative in soliciting input into improving his writing and grades; he is also exposed to a Community of Practice (in his peers) that is more invested in producing high quality writing (than the typical engineering class). Matthew’s writing grades increase significantly over the course of the quarter. Overall, Matthew’s academic performance (in writing) improves from
approximately 8th among his peers (of 12) to 4th. His level of engagement is expressed less so with his peers or in class (which is slightly less than average) than with the local on-site community on the Gulf Coast. He develops and pursues several meaningful connections with the community ranging from other civil engineers (working on rebuilding the local bridge) to recovering residents who talk enough to benefit from Matthew’s patient listening abilities.

With Matthew, we see a student who fits in at his home site, yet still shows significant improvements in sense of community as well as the outcomes of such improvements (academic engagement and performance). Just as in Bethany’s case, several key features of the off-campus, combined academic-service learning community experience seem to support this improvement. Matthew’s strong interest in bridges (and his term paper topic) is served well by his proximity to the construction and rebuilding of an important bridge (the US highway 90 bridge). He strongly engages with faculty, which may represent a return to his community college days, where he felt the accessibility and attitude of faculty were significantly greater than at the home campus.

**SERVICE LEARNING COMPONENT**

Both Bethany and Matthew made significant sacrifices in time to degree in order to participate in the Gulf Coast program. The level of sacrifice suggests a value to off-campus experiences that is not in sync with the low participation of engineering and other technical majors in off campus and service learning programs [7]. Much of the value, both educational and affective, in programs of this type lies in the inherent presence of Community of Learners principles. This program was unusual in that it is one of few off-campus volunteer efforts that intertwines the heavy representation of certain Community of Learners principles inherent in service learning (Community of Practice, Dialogic Base, Learning as an Active Process) with the traditional academic classroom experience. In so doing, it gains the benefits of Community of Learners while still attending to the college classroom constraints (low contact hours) that impede a more expansive implementation of Community of Learners in any university level course.

Our two case studies reflect that the top three expressed principles of Community of Learners (Community of Practice, Dialogic Base, Learning as an Active process) at the personal, professional, service, and academic levels contributed to an increased sense of belonging and community in the two engineering students evaluated. In the case of Bethany, these principles at the personal (enhanced social acceptance) and professional (increased technical competence) levels likely contributed most to overall sense of belonging. At the personal level, Bethany, finding herself in a diverse population of students (many of whom were also “minorities” at the service site by way of being not Christian or not Caucasian), was able to more readily integrate into her learning community, increasing her personal connections (Dialogic Base) with her peers well beyond her typical on-campus experience. Her sense of technical competence appeared to increase as a result of her hands-on exposure to her field (Learning as an Active Process), via off site trips and on-site independent study in a topic area of timely value and relevance to society. Bethany directly stated that the exposure to her field and the broader issues surrounding effective implementation of civil structures (via field trips) increased the educational value of the Gulf Coast program over traditional classroom experiences. Matthew, on the other hand, is a contrast to Bethany as he is considered a mainstream (majority) engineering student by virtue of being a Caucasian male. Via the Gulf Coast program, he gained a first exposure to a Community of Practice that integrated the academic experience with his non-profit career goals. Being integrated into a Community of Practice oriented toward service while still maintaining traditional academic activity improved his academic performance. He also benefited from his self-initiated dialogic base with other engineers in the community, specifically those invested in the “Blitz” rebuild of the Highway 90 bridge, a vital link to the outlying coastal communities. In addition, Matthew, by being surrounded by many students who both wrote well and enjoyed writing (a Community of Practice on its own), was able to make significant strides in improving his writing via active learning with his non-engineering peers. Such interdisciplinary communities of practice are highly desirable in colleges of engineering but difficult to realize on-campus due to sharper boundaries between disciplines and rigorous degree requirements.

No doubt, it is difficult to isolate which principles of Community of Learners and which external (to such a framework) factors contributed to which improvements in the engineering student learning experience. However, we can conclusively realize that the Gulf Coast program was of substantial benefit to both the academic performance and affective (including sense of community) experience of the engineering student.

**CONCLUSIONS**

The implementation of Community of Learners principles in an integrated academic/service learning program offered on the Gulf Coast of Mississippi in the aftermath of Hurricane Katrina has been described. Engineering undergraduates enrolled in the program thrived through the course of the program. Affective impressions of the program, especially those associated with sense of community, were far above the average for other students in engineering undergraduate classes. Additional observations and insights gained from focus groups expanded upon and explored the reasons for this increased sense of community. Academic performance for engineering students in the program trended well above the corresponding performance average (GPA) on campus at the home institution. Connections to community at all levels were
nurtured by the program, some through intentional design and some through the pervasive effects of circumstance. The impacts on non-engineering students were different than engineering students; in most cases, engineering students experienced more positive affective outcomes than those whose technical interests (and major choices) were low.

Overall, the most important lesson learned from the Gulf Coast experience is that immersive experiences for engineering students in a purposeful Community of Practice played a strong role in not only increasing the student’s connection to community but also in their integrated affective and intellectual experience. Results from other studies (in this same research program) show that attempts to mimic or simulate such immersions in the classroom, on-campus, are far less effective than real immersions. The significant benefits to engineering students of immersions in off-campus Community of Practice is at odds with the fact that participation in such immersions is drastically lower for engineers than for non-engineering students. In contrast to internships and many volunteer opportunities, the Gulf Coast program retained a thread to the academic examination of the Hurricane Katrina aftermath. Such integrated and immersed (Community of Practice) academic/service programs benefit the engineering student in a myriad of ways, in personal, professional, and academic development. Further exploration of the impact of these programs on student experience as well as additional offerings of such opportunities are likely to have benefit that well outweighs the costs of such programs.

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REFERENCES


