Connecting Environmental Engineers to the Klamath River via a Placed Based Learning Community

Elizabeth A. Eschenbach
Eileen Cashman
Environmental Resources Engineering
Humboldt State University
Arcata, California, USA
Elizabeth.Eschenbach@humboldt.edu
Eileen.Cashman@humboldt.edu

Matt Johnson[1]
Amy Sprowles[2]
Wildlife[1]
Biology[2]
Humboldt State University
Arcata, California, USA
Matthew.Johnson@humboldt.edu
Amy.Sprowles@humboldt.edu

***Abstract*—This innovative practice work in progress describes the Klamath Connection (KC) program at Humboldt State University (HSU). The KC Program is a place-based learning community designed to foster a sense of belonging to improve STEM first-year performance. Initiated through the California State University STEM Collaboratives project, the program is comprised of four high impact practices (a summer immersion, first-year seminar, modified gateway courses with block scheduling, and peer mentoring) woven around an interdisciplinary theme unique to our geographic location, the Klamath River Basin. Initially offered to HSU first-year students entering declared in one of four science majors, the Environmental Resources Engineering (ERE) program joined the KC for the '16/17' academic year as part of the second cohort. The second KC cohort self-report a heightened sense of belonging and stronger development of academic behaviors when compared to other first-year students in the same majors. KC ERE students had improved 1st term retention, GPA, and lower rates of academic probation. That same favorable comparison was seen for participants from traditionally underrepresented backgrounds, but not for those from low-income backgrounds. This paper describes the modifications made to the KC program to include the ERE students and discusses preliminary results.**

Keywords—First-Year Experience, Place-Based Learning, CSU STEM Collaborative

I. INTRODUCTION

The Klamath Connection (KC) program is a placed-based learning community[1] [1,2] It was designed to promote a sense of belonging and develop the academic skill and attitudes of first-year STEM students such that retention and graduation rates would improve for all participants. The program was developed and piloted in 2015 by the California State University STEM Collaboratives Program, which was supported by a $4.6 million grant from the Leona M. and Harry B. Helmsley Charitable Trust. The program implemented at Humboldt State University (HSU) has been identified as one of the most successful of eight programs funded within the 23 campus California State University (CSU) System via the CSU STEM Collaboratives project.

HSU is the northernmost campus of the CSU in a rural setting of redwood forests near the ocean. The ABET-accredited Environmental Resources Engineering (ERE) program is one of the oldest and largest accredited undergraduate environmental engineering programs in the country. In the past ten years, the demographics of the students has changed to include more women (35%) and other underrepresented students (35%). Almost half of the students are first generation to attend college and half are eligible for federal financial aid. HSU is now a Hispanic Serving Institution (HIS) with 34% of students reporting they are Hispanic. In addition, only 14% of our students are local with many of them coming from populated urban areas such as Los Angeles and the San Francisco Bay Area [3].

Over twenty years of research suggests learning communities improve the academic performance of the student participants [4,5]. Place-based education draws lessons from a local lens to broader contexts and applications, generalizing to and contrasting with other regions, human communities, and ecosystems [6,7]. In this way, place-based education provides a potential mechanism for students in unfamiliar settings to not only gain more regional familiarity, but to better recognize parallels and unique aspects of their of campus and familial homes.

The KC is a place-based learning community (PBLC), which links course content and extracurricular activities with an interdisciplinary theme unique to our region, the Klamath River. The program leverages access to the natural resources in the Klamath River watershed and engineering applications such as water supply, aquatic restoration, sustainable power generation, and fisheries. It involves faculty, students, staff and off-campus communities in five strategies shown to be effective in increasing diversity in STEM [8]: (1) a summer immersion experience, (2) block-scheduled gateway courses, a major-focused first-year seminar, (3) a major-focused first-year

[1]Our Learning community is defined as a common cohort of students enrolled in a cluster of two or more courses linked to an interdisciplinary theme or problem. Benefits of this model have previously been described (Smith et al 2009; Sommo et al 2012).

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seminar, (4) STEM peer mentors, and (5) academically themed housing. By designing assignments and activities around scientific, environmental, societal and cultural themes of our location, we hope to foster a sense of community, belonging and increased study skills and attitudes to ultimately result in improved retention and graduation rates.

This approach to increasing first-year STEM retention rates via the creation of a place-based learning community could be easily transferred to other universities interested in increasing retention rates and persistence in STEM majors. A program description, summary of results from the first KC cohort, and a review of the results from the first ERE cohort are below.

II. PROGRAM DESCRIPTION

A. Project Objective

The objective of this project is to build a place-based learning community for Environmental Resources Engineering students to realize the long-term goal of the project – to raise retention and graduation rates and close achievement gaps

B. Program Practices

We developed a place-based learning community that links five high impact practices (summer immersion, blocked scheduling, first-year seminar (FYS), peer mentoring, and academically themed housing) to a major feature of our geographic location: The Klamath River. The KC program involves HSU students, faculty, staff, and off-campus community partners including professional scientists, Native American tribal nations, and environmental restoration groups.

C. Program Components

1) Summer immersion.

Students in the program arrived to campus four days before the standard orientation program to participate in a "Summer Immersion" program. This four day program is comprised of activities designed to impart several messages to each participating student: (1) welcome to this exciting and diverse place and this academic community of learners, (2) you are a beginning scientist or engineer, and the application of scientific content at HSU begins immediately, (3) the outdoors are part of your "classroom", (4) solving complex social and environmental problems requires recognizing the interconnectedness of disciplines and working with others, (5) your peers can help you learn, and vice versa, and (6) you have a range of offices and people – faculty, staff, students – that are here to support you and help you succeed. Students are grouped by major and activities involve opportunities to introduce the students to each other, the HSU community, and the Klamath River watershed. They shared this experience with KC faculty, staff, peer mentors, and community partners. The people, places and thematic content they explore were linked to the academic year coursework.

Over the four days, students engage in field and lab-based academic activities that are designed to develop an academic mindset while creating community. For example, on their first day the students have the opportunity to visit a solar-powered micro grid project at the Blue Lake Rancheria or a constructed wetland system that treats all the wastewater generated in Arcata where HSU is located. The details of how both these engineered systems work are included in the curriculum for the first semester introductory engineering course. Another day, they travel an hour north of the HSU campus and meet with Yurok Tribal members and other professionals who manage the Klamath River watershed. Students learn about blue-green algae in the Klamath River, collect water quality samples at four different sites, and later in the week analyze the water sample for algal concentrations. The results of that analysis are interwoven into their first semester curriculum of their block scheduled courses. The students also participate in HSU's standard Humboldt Orientation Program with the rest of the incoming first-year students.

2) Blocked scheduling & gateway courses.

Students are grouped into cohorts by major and scheduled into specific sections of required major and general education (GE) courses, each of which was a requirement for an HSU degree. ERE students were fully block enrolled in the fall term in ENGR 115: Introduction to Environmental Resources Engineering, Pre-calculus or Calculus, Chemistry, English and a first-year seminar (16 units) and partially block enrolled in the spring term. Block enrolling is accomplished through collaboration of the KC Program Coordinator, HSU the Office of Admissions, the Office of the Registrar, and Mathematics. Some classes are 'exclusive', meaning only KC students were enrolled in the class (e.g., pre calculus), in other cases KC students were mixed with other non-KC students (e.g., ENGR 115), though in those cases KC students were enrolled in the same lab sections. Given the pre-requisite requirements for the first semester courses, all KC students had to enroll in Pre-calculus or higher the first semester.

To create a place-based curriculum, all instructors of block-enrolled courses were asked to aim at least some content of their course toward topics relevant to the Klamath River watershed. This ranged from a 3-week unit on water quality in the Klamath River in Introduction to Engineering to data analysis from their summer immersion experiment in their chemistry and math courses. There was a deliberate effort to link content across courses, and this was accomplished using the eutrophication experiment conducted as part of the Summer Immersion.

3) First-Year Seminar (FYS).

The existing 1-unit first-year seminar was modified for this program into KC specific First-Year Seminar courses (FYS). The FYS were led by faculty of each of the departments who worked together to develop a syllabus that combined a mixture of "university 101" type of material (introduction to techniques and services to help students become more successful) and an introduction/welcome to the major. Individual instructors agreed to a common basic template, but had considerable freedom to develop their own version for students in their major. The ERE FYS instructors built on previous curriculum developed through participation in the California Chautauqua workshop on introductory engineering courses [9].

4) Peer mentoring.

The KC program partnered with the HSU Retention through Academic Mentoring Program (RAMP), a program on campus that utilizes 1:1 peer mentoring to guide first-year students in their development of positive academic habits and study skills, introduce them to campus culture to help them find their

"niche", inform them about university policies and procedures, direct them to campus and community resources and services, and provide support through their transition to becoming college freshmen. Current HSU policy is to assign RAMP mentors to all incoming first-generation freshmen. We expanded this so that all KC students would have a RAMP mentor, regardless of first-generation status. The RAMP peer mentors were STEM students assigned to KC students by FYS section. When possible, the RAMP mentor was the same major. As most RAMP mentors maintained caseloads of ~25 students, so most had additional mentees not in the KC program. The approach to peer mentoring for KC students was generally similar to that for non-KC students, though communication between mentors, the mentees' faculty, and program staff was enhanced relative to non-KC students because of the integrative nature of the KC program.

5) Academically-themed housing.

The KC program partnered with the HSU Residence Life staff to facilitate themed-housing for KC students. Participation in the themed-housing was not required but strongly encouraged for first-year students. The Residence Life staff coordinated with the program to plan field trips that were fun and related to KC student majors such as visits to Redwood National and State parks. Students were able to attend group tutoring sessions and professor-led exam review sessions that were held in a special classroom on the bottom floor of the residence hall.

6) Extra-curricular activities.

In an effort to continually engage students, foster community, and illustrate links between disciplines, there were a number extra-curricular activities throughout the year. including a dramatic reading of the play (and Book of the Year) Salmon is Everything, a trip aboard the university research vessel the Coral Sea, a visit to the Ah-Pah Traditional Yurok Village, a guest lecture on traditional ecological knowledge, an end-of-the semester game party, and a native art-exhibit and an end of the year tie-dying party. Many of these activities were in collaboration with both on and off campus partners, further illustrating the importance of community. For the ERE cohort, students were encouraged to participate in a volunteer activity in the community. Volunteer training for participation in the Zero Waste Humboldt initiative was provided and students volunteered at local festivals.

III. Results From First-year Cohort

The following summarizes the results from the first cohort, for AY 2015-16, was comprised of 63 freshmen entering HSU declared in one of HSU's four largest STEM majors: Biology, Environmental Science, Wildlife, or Zoology. There were no ERE students in this first cohort, but results are presented to provide context.

A. Academic Belonging, Community, and Development of Academic Skills

Two survey instruments were developed in collaboration with the HSU Office of Retention and Inclusive Student Success. The first was a "pre-FYS" survey given to all KC students and to all non-KC also enrolled in their major's FYS course within the first week of classes. The survey responses suggest the Summer Immersion was helpful in fostering a sense of belonging and community as compared to the non-KC students [1].

Another key survey instrument for the campus is delivered via the Skyfactor©-Mapworks platform (herafter "Mapworks surveys"). The Mapworks surveys contain dozens of questions on a Likert scale. The responses are summarized into 23 factors that the academic literature suggests are associated with student retention and success [10]. It was given to the first-year cohort in the middle of the fall semester and again in the mid-spring with generally high response rates (60% fall; 30% spring). Overall, results suggest that compared to the non KC students, KC students gained a stronger sense of belonging, and better developed academic skills over the course of the academic year. KC students reported having less anxiety and feeling less upset before an exam, and having less worry about exam performance than did non-KC students; and KC students reported a higher degree of confidence that they would pick HSU again if they had to do it over, that they would recommend HSU to someone who wants to attend college, and an overall positive experience at HSU.) [1].

B. Academic Performance

The experimental design for the first cohort was not a strict randomized controlled trial, but rather a quasi-experimental design in which we compared academic performance between KC students and the most meaningful possible reference group. The KC students earned higher final grades than did non-KC students in core science and math courses, and those differences were statistically significant for all cases except two classes. Especially noteworthy is that rates of "non-success" (D, F or withdrawal) were markedly lower for KC than non-KC students in all science and math courses [1].

Likewise, KC students tended to earn higher final grades than did non-KC students non-science GE courses [1].

C. First-year Retention and Progress Toward Degree

First-year retention rate is defined by the CSU System as the percentage of students still enrolled at HSU after Fall census of their second year. First-year retention was twelve percentage points higher for students in the KC than for the reference group (84% vs. 72%). Though this effect was only marginally statistically significant the 84% retention was higher than any first-year retention rate recorded by the College of Natural Resources and Sciences in the past 10 years [1].

Compared to the non KC students, students in the KC earned, on average, 2.1 more units toward their major (9.8 vs. 7.7) and 4.1 more units toward general education and all university requirements (20.0 vs. 15.9). In addition, although not statistically significant, gaps in earned units between URM, first generation, and low-income students and traditional majority students tended to be smaller (or reversed) for the KC students than for the reference group.

D. Qualitative Perceptions of Student Engagement

The following two quotes from KC students from the first cohort capture the extent that students engaged in their academic community

"If the last few months were to be composed into a flip

book, so many of those smiling and laughing moments would have some sort of Klamath Connection caption. This experience has taught me how to attempt think critically, directly apply math to science, publicly speak, and think about plants way too much. Overall, I can truly say that these classes in combination with such a blossoming program has truly paved the way for me to become a scientist. "

"I liked how we were able to talk to our professors whenever we needed help because we had a closer relationship with the professors through the summer immersion then the other students had with them who weren't part of the immersion"

IV. Preliminary Results From Environmental Resources Engineering Students

The ERE program joined the KC program for the 2016-2017 academic year and students recently completed the second semester of the program. This work in progress paper reports quantitative results that are available at the time of publication.

A. Academic Belonging, Community, and Development of Academic Skills

Results from end of year surveys will be reported at the conference if available.

B. Analysis Academic Performance

A preliminary analysis of the first year for the ERE students suggests that the KC program benefitted ERE students. After two semesters, overall GPAs were higher for KC than non-KC students (2.53 vs. 2.18), and this difference was larger for students traditionally underrepresented in science and engineering (2.49 vs. 1.61). In addition, a higher percentage of underrepresented students were in good academic standing in the KC program at the end of the year (73% vs. 57%).

C. First-year Retention and Progress Toward Degree

After the first semester, KC students had a higher retention rate in the major (97% vs. 81%). These results are not statistically significant due to very small numbers on non-KC students in the ERE major. First-year retention data are not available until fall census in 2017. After the spring semester, KC students completed more units toward an engineering degree than did non-KC student (13.7 vs. 8.0), and this difference was especially pronounced for underrepresented students (13.8 vs. 4.4). Results from end of year summaries will be reported at the conference if available.

D. Qualitative Perceptions of Student Engagement

The first two authors have taught the FYS for many years. The KC ERE students came into the first class with a strong sense of momentum. In the past, FYS students would be afraid to speak up in front of one another. However, during FYS sessions, there was boisterous involvement with each session. The group pushed and encouraged each other.

The ERE students are completing their second semester of chemistry with the same instructor. The instructor has the following comment:

"I think KC does make a difference - along with the Freshman seminar. Your ERE group is coming to age and they are really starting to separate from the pack in CHEM 110. They are tight. For example, Gannon will stay as an ERE major. I think it is more about staying with his cohort than going with Chemistry. He was on the fence but that connection part of KC is great for students."

The instructor of NAS 200: Native American Studies 200: Indigenous Peoples in US History has said he loved having the KC ERE students in his class during the spring semester. The students are not afraid to say what they think and they challenge each other intellectually and publically.

While advising a first-year Non-KC student this spring, the first author learned that the advisee was only now beginning to get to know the other ERE students. She said she wished she had chosen to take part in the KC program, as "the other kids started the fall semester knowing each other"

V. Future Activities & Questions

Because of the success of this program HSU has received an HSI STEM award and an HHMI Inclusive Excellence award, which will support expansion and implementation of first-year learning communities to support approximately 75-80% of all incoming STEM freshmen over the next five years.

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