Results from First Cohort of the Klamath Connection
HSU's CSU STEM Collaboratives Project

Matt Johnson, Amy Sprowles, Katlin Overeem, Angela Rich

Abstract. The Klamath Connection Program is a place-based learning community designed to foster a sense of belonging to improve STEM freshman performance. Initiated through the CSU STEM Collaboratives project, the program is comprised of four high impact practices (a summer immersion, freshman year seminar, modified gateway courses, and peer mentoring) woven around an interdisciplinary theme unique to our geographic location, the Klamath Basin. Data from the first cohort show Klamath Connection students self report a heightened sense of belonging, community, academic skills, and attitudes when compared to other freshman in their majors. They scored higher in nearly all first year core science, math and GE courses, had higher overall first year GPAs, completed more units toward a degree, and had increased retention into the sophomore year (84% vs. 72%). Gaps for underrepresented minority and first-generation students almost disappeared in the first semester Botany course, first year GPAs, and units completed toward degree. Nonetheless, there are several important caveats to consider when evaluating this trial. Also, as with any first-time experiment, there were several lessons learned, prompting modification for the second cohort, which has grown to serve more majors and students. Funding from our 2016 HSI STEM award will support expansion and implementation of freshman year learning communities to support ~75-80% of all incoming STEM freshmen over the next 5 years, with continued assessment and plans to institutionalize practices that remain effective.

Background & Need

Humboldt State University's student demographic has changed rapidly over the last six years. The most remote of the 23 California State University campuses, HSU is located in a rural setting with a predominantly non-Hispanic white population (~75%). Since 2009, enrollment of underrepresented minority first-time freshmen in STEM majors has increased by over 80%. The majority these students arrive from distant urban centers elsewhere in California. Since 2010, HSU has seen a 23% increase in low-income students, and 46% of incoming freshmen require pre-collegiate coursework. In 2013 HSU became a federally recognized Hispanic Serving Institution. In 2014, HSU enrolled its largest and most diverse class, with nearly half of the incoming class from underrepresented groups. In 2015, over 55% of HSU's first time undergraduates were first-generation students, and this proportion rises to 70% among underrepresented students. It is a new era. These students are the new majority and reflect the future workforce and graduate students in STEM disciplines.

This change presents challenges for the campus to achieve inclusive success, especially for first-time freshmen. The average six-year graduation rates for first-time freshmen at HSU is 42%, lagging about 8 percentage points behind the CSU-wide average. Unlike at many other universities, which typically have lower graduation rates in STEM than in non-STEM disciplines, the graduation rate for STEM students at HSU is

about the same as the university-wide average (43%). However, there is a disturbing gap in graduation between URM and non-URM students at HSU: graduation rates for URM students are 14 percentage points lower than for non-URM students, and this gap is even wider (by an additional 8 percentage points) in STEM disciplines (HSU Office of Institutional Effectiveness).

Six semesters of survey data collected by the Office of Institutional Effectiveness and the Office of Retention & Inclusive Student Success show that HSU is not adequately helping the new majority student develop the perceptions and behaviors associated with success. Specifically, compared to other students, underrepresented students at HSU show 1) lower sense of belonging on campus (-4%), 2) lower perception of self-efficacy (-4%), 3) lower feelings of resilience (-5%), and 4) lower development of academic behaviors (-3%). In turn, three negative predictors of successful graduation are manifest from these challenges: 1) lower scores in foundational science courses (-13%), 2) lower first term GPAs (-10%), and 3) higher rates of academic probation (+17%).

Objective

The rapidly changing demographic at HSU has made it difficult to cultivate an inclusive community of learners, one in which students, faculty, and staff all feel a common purpose, welcomed, and valued. The objective of this project has been to build a trial *place-based learning community* for incoming STEM students. Our hypothesis is that by building such a community, we can effect change in student and faculty culture, foster in students the skill and habits that favor academic success, and improve student performance in foundational courses. Our model hypothesizes a logical cause-effect chain that leads, ultimately, to realizing the long-term goal of the project – to raise retention and graduation rates and close gaps between the new majority and traditional students (Fig. 1). In this report, we describe the practices and results from the first cohort of the Klamath Connection. In the Discussion, we briefly describe modifications for the second cohort.

Figure 1. Hypothesized cause-effect chain that leads to higher retention and graduation rates, and closed gaps between 'new majority' and traditional students.

Program practices

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

Recruitment & Enrollment

To date, the program has followed on "opt-in" model: all freshman who have declared one of the participating majors in their application materials were sent invitations to participate once they receive their acceptance or provisional acceptance to HSU (Jan/Feb)[1]. Later in the spring, we followed more focused outreach (e.g., emails from the program, calls from staff and faculty). Students were also invited to join the optional Klamath Connection themed housing in the residence halls. Next, we worked with students, the Math and English Departments, and Admissions to determine the Math and English needs of each student to enable block enrollment. The first cohort, for AY 2015-16, was comprised of 63 freshmen entering HSU declared in one of our four largest STEM majors: Biology, Environmental Science, Wildlife, or Zoology.

Program Components

Summer immersion. Students in the program arrived to campus four days before the standard Humboldt Orientation Program (HOP) to participate in a "Summer Immersion" program. This four day program was 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, and 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 were grouped by major and activities involved opportunities to introduce the students to each other, the HSU community, and the Klamath Basin. They shared this experience with Klamath Connection faculty, staff, RAMP peer mentors, and community partners. The people, places and thematic content they explore were linked to the academic year coursework.

The first summer immersion explored two different models: an on campus experience, where students participated in off campus activities that included a day trip to the Klamath River, and an off campus experience, where students camped on the Klamath River for two nights with Klamath Connection Faculty and Staff (Table 1). Both experiences included interaction with scientists, natural resource policy professionals and cultural experts from Native American Tribes. The camping students spent a day with employees of the Karuk Department of Natural Resources, learning about the importance of the Klamath River to the tribe and learning how the scientists in the tribe's water quality department participate in the data collection and monitoring of the Klamath River. The campus-based group spent the day at the mouth of the Klamath with Yurok tribal leaders and field scientists, learning how this tribal nation actively participates in scientific data collection, policy formation and environmental management. All students collected water samples that were be brought back to campus. Some were used in a laboratory experiment on the last day of the last day of the summer immersion, the rest was frozen for use in their spring chemistry course. From Wednesday-Friday, the students participated in HSU's standard Humboldt Orientation Program with the rest of the incoming freshman.

[1] HSU has a fairly low yield rate (i.e., many students who apply and are admitted choose not attend HSU), so this initial recruitment is large.

Table 1. Schedule for summer immersion activities.

Saturday	Sunday		Monday		Tuesday	
	Campus	**Camping**	**Campus**	**Camping**	**Campus**	**Camping**
Move In	Welcome; Intro to note-taking and the Arcata Marsh	Welcome; Video "A river Between us"; Introduction To Camping and Klamath Culture	Travel by bus to Klamath	Introduction to Karuk Culture, The Klamath River, Science and Policy by Karuk Tribe DNR Employees[2]	Water Quality Laboratory Experiment	Pack up camp; Return to campus
Parent Orientation	Arcata Marsh Field trip, picnic lunch, arranged by major[3]	Travel to campsite; Water Collection	Welcome reception and introduction to tribal natural resource management by tribal personnel	Tour of Klamath by Karuk Water Quality Department	Peer mentor reflection and registration lab	Water Quality Laboratory Experiment
Student Team-Building with RAMP	Students discussions of lessons learned in re-arranged small groups	Set up Camp Introductory Activities with Faculty[4]	Rotations among scientists-led field experience (arranged by major, each major groups visits two stations/scientists)[5]; picnic lunch	Water sampling and Swimming	Pizza party at Moonstone Beach	Pizza party at Moonstone Beach
Welcome Dinner on the Events Field	After dinner view of *A River Between Us* (portion)	Introduction to Blue Creek Assignment	Mentored study time in the library to complete Blue Creek assignment	Indian Taco Dinner at Karuk DNR		
Welcome Event	Introduce Blue Creek academic assignment			Mentored time to complete Blue Creek Assignment		

[2] Lisa Hillman, Pikyav Field Institute Program Manager delivered a cultural history of the Karuk Tribe and the Klamath; Craig Tucker, Environmental Policy Advocate describe how the Karuk Tribe contributes to science and management of the basin; Chook-Chook Hillman, DNR Water Quality Scientist, demonstrated water quality sampling and gave a tour of the laboratory.

[3] WLDF with Jeff Black, ZOOL with Matt Johnson, BIOL with Frank Shaughnessey, ENVS with Alison O'Dowd

[4] BIOL Patty Siering, Ph.D. CHEM Matthew Hurst, Ph.D, WILDF Gillian Black, PhD. Camp host David Baston, CNRS Core Facility Coordinator

[5] Chris West (Yurok Tribe employee and HSU alum) provided information about wildlife topics; Dave Hillemeir (Yurok Tribe employee and HSU alum) provided information about fisheries; Dawn Goley (HSU Biology) provided information about zoology & ecology at Klamath Mouth; Rocco Fiorini (consultant for Green Diamond and HSU alum) provided information about stream restoration. Each major visited two stations/scientists: WLDF (West & Hillemeir), ZOOL (Goley & West), BIOL (Fiori and Goley), ENVS (Hillemeir and Fiori).

Blocked scheduling & gateway courses. Students were 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. We worked with department chairs to align the fall semesters of all participating majors as much as feasible (Table 2), which in some cases required deviating slightly from the current "first-year maps" The students were fully block enrolled in the fall term (14-17 units), but only partially block enrolled in the spring term. This was purposeful so that students did not need to learn the complexities of registration and course selection before arrival, but were given the opportunity to select some courses in consultation with their academic advisors to learn the registration process in preparation for the spring semester. Block enrolling was accomplished through collaboration of the Klamath Connection Program Coordinator (Katlin Overeem), HSU the Office of Admissions (Steve Ladwig), the Office of the Registrar (Clint Rebick and Travis Brunner), and Mathematics (Jeff Haag). Some classes were 'exclusive', meaning only Klamath Connection students were enrolled in the class (e.g., FOR 100), in other cases Klamath Connection students were mixed with other non-KC students (e.g., BOT 105), though in those cases Klamath Connection students were enrolled in the same lab sections. Since the second semester schedule included a course with math prerequisite (Chemistry), all Klamath Connection students had to enroll in Math 113 or higher the first semester.

The curriculum of the block courses was modified only slightly, but in important and, we believe, meaningful ways. All instructors of block-enrolled courses were asked to aim at least some content of their course toward topics relevant to the Klamath River or Basin. In some cases, such as in FOR 100 and NAS 104, this redirect was fairly substantial. In others, such as BOT 105, there was relatively little change to course content (e.g., a single lab was modified to more purposefully connect microscopy of blue green algae to the ecology of the river). However, there was also a deliberate effort to link content across courses, and this was accomplished using the eutrophication experiment conducted as part of the Summer Immersion. In the Fall semester, data from the experiment were analyzed in the students math courses, the logic of the research design was discussed in the critical thinking course (FOR 100), and the biology of the algae was discussed in botany. At the end of the semester, instructors from all of these courses convened simultaneously in the FOR 100 course to discuss with students how these disciplines connected around this topic. In the Spring semester, components of this topic were raised again in WLDF 210 and NAS 104, by articulating them with wildlife conservation and social justice, respectively.

Table 2. Klamath Connection Block-enrolled courses for AY 2015-2016.

Fall	**Spring**
Intro Botany (BOT 105, major and GE Area B)	Intro/Fundamental Chemistry (CHEM 107 or 109[3], major and GE Area B)
Math[1]	Intro Native Am. Studies or Natural Resource Conserv.[4] (NAS 104 or EMP 105, GE Area D)
Oral Communication (COMM 100, GE Area A)	Intro Wildlife[5] (WLDF 210)
Critical thinking (FOR 100 ,GE Area A)	
Freshman Year Seminar (FYS)[2]	

[1] Depending on preparedness (113, 115, or 105)
[2] Depending on major (WLDF 111, ENVS 111, BIO 180)
[3] Depending on major (107 for WLDF & ENVS, 109 for all BIO)
[4] NAS for all but ENVS majors
[5] Only for WLDF majors

Freshman Year Seminar (FYS). The existing 1-unit introductory courses from each of the participating majors (WLDF 111, ENVS 111, BIOL 180), were modified for this program into Klamath Connection specific Freshman 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. Common exercises included an "exam wrapper", designed to help students identify gaps in their study strategies, note-taking for BOT 105, and oral presentation practice for COMM 100. Most instructors organized field trips and professional panels to incorporate major-based content. FYS size was limited to 18 students/section.

Peer mentoring. The Klamath Connection program partnered with the HSU Retention through Academic Mentoring Program (RAMP), a program on campus that utilizes 1:1 peer mentoring to guide freshman 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 science 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.

Extra-curricular activities. In an effort to continually engage students, foster community, and illustrate links between disciplines, we arranged a number extra-curricular activities throughout the year, including: (1) a dramatic reading of the play (and Book of the Year) *Salmon is Everything*, (2) a trip aboard the *Coral Sea*, (3) a visit to the Ah-Pah Traditional Yurok Village, (4) a guest lecture on traditional ecological knowledge by Dr. Seafha Ramos, (5) an end-of-the semester game party, (6) a start of spring term cup-cake party, (7) a native art-exhibit in the Goudi'ni Gallery, (8) a guest lecture by an ecologist and alum who studied the (dam-removed) Elwha River, (9) documentary film showings of *Return of the River* (Elwha River), *Battle for the Klamath* and *River Between Us* (Klamath) (10) an informational session about the latest on dam removal agreements, and (11) 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 (Table 3).

Table 3. Extra-curricular activities for the first Klamath Connection cohort.

Activity	Collaborators
Salmon is Everything Staged Reading	RISS, Department of Theater, HSU Library
Ah-Pah Visit	Humboldt Area Foundation, Yurok Elder Willard Carlson, Thomas Duncan
Native Art Exhibit /Artist Presentation	HSU Goudi'ni Gallery
Traditional Ecological Knowledge (TEK) Lecture	Wildlife Biologist, TEK Expert and Yurok Tribal member Seafha Ramos, Ph.D.
Film Events and Panel Discussion	HSU Book of the Year, Klamath Justice Coalition and Yurok Tribal Member Frankie Meyers, Karuk DNR Policy Advocate Craig Tucker
Klamath Science Day	Poster Session and Panel Discussion with experts doing research on the Klamath (Kari Norgaard, Ron Reed, Merve George Jr., HSU graduate students)
Tie Dye Party	HSU Housing

Through all of these integrated practices and activities, the program offered a substantively re-imagined first year experience for freshmen. To our knowledge, this is the first attempt HSU has made to create a comprehensive and interdisciplinary cohort based learning community, and it is one of the only attempts to make that community "place-based" by focusing on a regionally unique landscape strongly associated with geography of which the university is a part.

Results

Demographics

For AY 2015-2016, there were 63 students in the Klamath Connection program: 25 Biology majors (several emphases), 17 in Wildlife, 13 in Zoology, and 8 in Environmental Science. For analytical purposes, we restrict comparisons of student demographics in the Klamath Connection to all freshmen in these four majors (Table 4). The ratio of female to male students was lower in in the Klamath Connection cohort than among non-KC freshmen in the four target majors, though this difference was not statistically significant. The proportion of first generation students was similar between the Klamath Connection and non-KC freshmen the four target majors (56% vs. 60%, respectively). The proportion of low income students in the Klamath Connection was slightly lower than among non-KC freshmen the four target majors (47% vs. 61%, respectively), though this difference was not statistically significant. The distribution of region of origin is similar between the Klamath Connection program and non-KC freshmen in the four target majors (~35-40% LA, ~20-25% SF Bay Area and Northern California, ~10-15% out of state, and <5% local). The ethnicity breakdown between Klamath Connection and non-KC freshmen in the four target majors show some similarities, but also some notable differences. Specifically, though small, the percentage of some underrepresented groups was higher in the Klamath Connection program than among overall freshman in the four target majors: American Indian (3% vs. <1%), Asian American (6% vs. 2%) and two or more races (6% vs. 4%). None of these was statistically significant, however. In contrast, the percentage of Hispanic/Latinx students was lower in the Klamath Connection program than among non-KC freshmen in the four target majors (22% vs. 42%). This lower proportion of Latinx students is only partially compensated for by the higher numbers of other underrepresented groups, so the percentage of URM students was statistically lower in the Klamath Connection than among non-KC freshmen in the four target majors (34% vs. 56%, respectively; URM was defined as African

American, American Indian, Pacific Islander, Hispanic/Latinx, or two or more if it included one the previous). The range of high school GPAs overlapped between Klamath Connection and non-KC students, though the mean was non-significantly higher in the KC group.

Table 4. Demographic breakdown of Klamath Connection students and non-Klamath Connection students (% of known) for AY 2015-2016.

	Klamath Connection (n = 63)	Non-Klamath Connection[1] (n = 266)	Statistics[2]
Female	40 (64%)	197 (72%)	$\chi^2 = 2.82$, *NS*
Male	23	69	
URM[2]	20 (34%)	138 (56%)	$\chi^2 = 6.86$, $P < 0.01$
Non-URM	35	109	
Unknown	4	14	
First-generation	34 (56%)	156 (60%)	$\chi^2 = 0.37$, *NS*
Non-first-generation	27	104	
Unknown	2	6	
Low-income	28 (47%)	151 (61%)	$\chi^2 = 3.87$, *NS*
Non-low-income	32	98	
Unknown	3	17	
High School GPA[3]	3.54±0.19	3.41±0.08	$t = 2.45$, *NS*

[1] First-time freshmen in the same target majors (Biology, Zoology, Env. Sci, and Wildlife)

[2] χ^2 tests have one degree of freedom; we used Bonferroni adjustment to alpha to compensate for multiple comparison ($\alpha = 0.01$); NS = non-significant; GPA was examined with a *t*-test.

[3] Not available for all students, value is mean ± 1 SE

Survey instruments were designed in collaboration with the Office of Retention and Inclusive Student Success (Angela Rich) to evaluate students' perceptions, attitudes, and self-reported study skills. Survey instruments were administered by the program to students in KC and non-KC FYS courses (FYS surveys) or by the Office of Retention and Inclusive Student Success (to all freshmen; MapWorks surveys). We used scores and grades in courses to examine academic performance obtained from the Office of Institutional Effectiveness and individual instructors. To examine retention and progress toward degree, we used fall 2016 census data (1 year retention) and units earned toward major obtained from the Office of Institutional Effectiveness.

Academic Belonging, Community, and Development of Academic Skills

We administered a "pre-FYS" survey to all Klamath Connection students and to all non-KC also enrolled in their major's FYS course within the first three weeks of the fall semester (i.e., the "non-KC" version of BIO 180, ENVS 111, or WLDF 111). The responses to every question were more favorable for KC students than for the reference group, and several of them significantly so (Table 3). Since at this point in the semester the primary difference between groups was participation in the Klamath Connection Summer Immersion (non-KC students only participate in

HOP), these data strongly suggest that the Summer Immersion was helpful in fostering a sense of belonging and community. There were no significant differences in responses by students in campus-based vs. the camping Summer Immersion Experience.

Table 5. Percent agreeing or strongly agreeing to questions on the "pre-FYS" survey instrument.

Connections & resources	**Klamath Connection**	**Reference[1]**	**χ^2**
It is important for me to help my peers learn.	64.5	79.8	*NS*
I understand what academic integrity is.	98.4	94.1	*NS*
I feel connected to other students in my freshman year seminar.	74.6	36.2	$P < 0.001$
Solving environmental problems involves collaboration from multiple disciplines.	100.0	94.7	*NS*
I am aware of campus resources that can help me complete my goal of a Bachelor of Science degree.	95.2	82.4	$P = 0.024$
It is important for my peers to help me learn.	61.3	59.4	*NS*
I know what career I would like to pursue after completing my degree.	56.9	56.0	*NS*
I understand the value of academic integrity.	100.0	93.1	*NS*
I feel part of the HSU community.	88.9	70.2	*NS;* $P = 0.02$
Confidence about future:			
I am inspired to be a scientist.	91.8	83.6	*NS*
I am optimistic about my future in science.	95.2	84.1	*NS;* $P = 0.04$
I am excited to be in a science major.	100.0	91.9	*NS*
I am ready to put in the work to be a science major.	100.0	94.6	*NS*
I am worried that science might not be for me. (score is % disagreeing or strongly disagreeing)	93.3	64.6	$P < 0.01$

[1] Reference group was non-KC students enrolled in the non-KC version of the target majors' freshmen year seminars.

The same survey instrument was administered as a post-FYS survey in the last two weeks of the fall semester. These results show the scores for the reference group rose significantly to approach those for the KC students, while KC students' responses generally stayed high. Consequently there were no significant differences in the responses between KC and non-KC students. However, the percent of KC students disagreeing or strongly disagreeing with the worry "that science may not be for me" dropped from 93.3% in the pre-FYS survey to 70.2% in the post-FYS survey, while this figure stayed nearly constant for the reference group(,64.6% to 63.9%). This drop in KC students' perceptions could reflect a more informed assessment of their interest in science after gaining more substantive experience with science. In this sense, the program may accelerate the acquisition of experience and knowledge by which students could make informed decisions about whether a major is right for them. These surveys were anonymous, so it is not possible to disaggregate them by ethnicity or other demographic characteristics.

Another key survey instrument for the campus is delivered via the Skyfactor©-Mapworks platform. The Mapworks surveys MapWorks 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. All HSU freshmen are asked to take the survey in the middle of the fall semester and again in the mid spring. Response rates are generally high (60% fall; 30% spring). MapWorks factor scores were compared between KC and non-KC freshmen in the target majors. Data were not normally distributed, so Mann-Whitney U tests were performed. Overall, results of MapWorks surveys suggest that compared to the reference group, KC students gained a stronger sense of belonging, and better developed academic skills over the course of the academic year (Table 6). Specifically, there were no statistically significant differences between the KC and reference group in the fall surveys (mid-fall), yet by the spring surveys, five key differences emerged. First, in Spring 2016, KC students reported a higher commitment to completing a degree at HSU and returning to HSU for the next term. Second, KC students reported having more discipline, dependability and follow-through than did students in the Reference group. Third, KC students reported greater senses of belonging, fitting in, and satisfaction with their social lives on campus than did students in the Reference. Fourth, Klamath Connections 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. And fifth, KC students reported having less anxiety and feeling less upset before an exam, and having less worry about exam performance than did students in the Reference group.

In examining the change in scores from fall to spring, we see that KC students reported having more discipline, dependability and follow-through in the spring semester than they did in the fall semester. They also reported greater senses of belonging, fitting in, and satisfaction with their social lives on campus in the spring than in the fall semester. There were no such differences for the Reference group. In contrast, the Reference group reported a lower commitment to completing a degree at HSU in the spring than the fall semester. They also reported having less discipline, dependability and follow-through and a lower degree of confidence that they would pick HSU again if they had to do it over (Table 6).

Table 6. Statistically significant[1] differences in factor scores of MapWorks surveys for Klamath Connection students and a Reference group.

FACTOR	Fall 2015: KC vs. Reference Group	Spring 2016: KC vs. Reference Group	Klamath Connections: Fall 2015 vs. Spring 2016[2]	Reference Group: Fall 2015 vs. Spring 2016[2]
Commitment to the Institution		**KC > Reference**		-
Self-Assessment: Communication Skills				
Self-Assessment: Analytical Skills				
Self-Assessment: Self-Discipline		**KC > Reference**	+	-
Self-Assessment: Time Management				
Financial Means	**KC > Reference**			
Basic Academic Behaviors				
Advanced Academic Behaviors				
Academic Self-Efficacy				
Academic Resiliency				
Peer Connections				
Homesickness: Separation				
Homesickness: Distressed				
Academic Integration				
Social Integration		**KC > Reference**	+	
Satisfaction with Institution		**KC > Reference**		-
On-Campus Living: Social Aspects				
On-Campus Living: Environment				
Campus Living: Roommate	**Reference > KC**			
Off-Campus Living: Environment				
Test Anxiety		**Reference < KC**		
Advanced Study Skills				

[1] Based on Mann-Whitney U tests ($\alpha = 0.05$)

[2] "+" indicates a significant increase in scores from the fall to the spring survey, "-" indicates a significant decrease

Academic Performance

Our experimental design 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 (Table 7). The rigor of these comparisons varies depending on the existence of potential confounding variables. For example, comparisons of KC and non-KC student performance in the BOT 105 course are relatively rigorous because all students were in the same course with the same instructor – that is, KC and non-KC students were mixed together. For some of these analyses High School GPA was used by using GPA as a covariate to help diminish possible lingering effects of self-selection in the KC program (i.e., a form of propensity matching analysis). In other cases, the same instructor taught multiple sections of a course, some of which were comprised of KC students and some were not (e.g., COMM 100). In still other cases, the KC and non-KC students took the same course number, but in different sections and with different instructors (e.g., FOR 100); in these cases, we have less confidence that observed differences in student performance are strictly due to the Klamath Connection program.

Table 7. Characteristics of academic performance of Klamath connection and non-Klamath connections students in individual courses.

Course	Section	Instructor	Covariate
Fall:			
Intro Botany (BOT 105)	Mixed	Same	High school GPA
Oral communication (COMM 100)	Separate	Same	
Freshman year seminar	Separate	Same	
College Algebra (MATH 115)	Separate	Different	
Stretch college algebra (MATH 113)	Separate	Different	
Critical thinking (FOR 100)	Separate	Different	
Spring:			
Intro/Fundamentals Chemistry (CHEM 107 or 109)	Mixed	Same	High school GPA
Intro Native Am. Studies (NAS 104)	Mixed	Same	
Intro Wildlife (WLDF 210)	Separate	Same	

We found that Klamath Connection students earned higher high final grades than did non-KC students in core science and math courses, and those differences were statistically significant for all cases except CHEM 107 and WLDF 210 (Fig 2). 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: BOT 105 (9% vs. 34%), MATH 113 (0% vs. 35%), MATH 115 (7% vs. 33%), CHEM 107 (6% vs. 21%), CHEM 109 (12% vs. 32%), and WLDF 210 (15% vs. 25%). The number of KC students in EMP 105 was too small to meaningfully analyze (<10).

Likewise, Klamath Connection students tended to earn higher final grades than did non-KC students non-science General Education courses (Fig. 3). Specifically, the distribution of scores was significantly higher for KC than non-KC students in COMM 100. Scores were not significantly different from KC and non-KC students in FOR 100 and NAS 104, though the non-success rates were lower for KC than non-KC students (8% vs. 15% for FOR, 5% vs. 10% for NAS). The pass rate was also higher for KC than non-KC students in their FYS courses (which are credit/no-credit; 96% vs. 81%).

In the courses with large enrollment and the most rigorous reference group (KC and non-KC students in the same section and with the same instructor – BOT 105, CHEM 109), we performed additional analyses of Freshmen only, taking into account High School GPA as a covariate to help diminish any possible lingering effects of self-selection in the KC program. In these cases, we used final percentage in the course as the response variable and also disaggregated students based on URM, first-generation, and low-income status. We found that in BOT 105, scores for KC students were generally higher than for non-KC students, and also that gaps in performance between students groups were almost eliminated (Fig. 4). There were fewer significant differences in the analysis of CHEM 109, but we found that underrepresented students in the Klamath Connection program tended to do as well or better than their more traditional counterparts.

Overall earned first year GPAs were significantly higher for Klamath Connection students than for students in the reference group (KC adjusted GPA = 2.76±0.11, reference GPA = 2.48±0.05; 2-way ANCOVA F = 5.72, df = 1 and 328, $P = 0.02$) (Figure 5). Correspondingly, the percent of students in good academic standing after one year was significantly higher for Klamath Connections students than for the reference group (90% vs. 72%, $\chi^2 = 9.57$, df = 1, $P < 0.01$). Though not statistically significant, gaps between URM, first generation, and low-income students and traditional majority students tended to be smaller or reversed for the Klamath Connection students than for the reference group. The high rate of good academic standing for Klamath Connection students did not significantly vary for URM students (85%), first-generation students (91%), or low-income students (96%), whereas it tended to be lower for these students in the reference group (72%, 68%, and 72%, respectively).

First Year Retention and Progress Toward Degree

First year retention rate is defined by the California State University 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 Klamath Connection than for the reference group (84% vs. 72%). Though this effect was only marginally statistically significant ($\chi^2 = 3.82$, df = 1, $P = 0.05$), 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 (Fig. 6). The STEM retention rate, meaning the percentage of students still enrolled and majoring in a STEM discipline after Fall census of their second year, was thirteen percentage points higher for Klamath Connection students than for the reference group (73% vs. 63%; $\chi^2 = 3.77$, df = 1, $P = 0.05$). These retention rates did not differ statistically significantly for URM vs. non-URM students in the Klamath Connection (all $\chi^2 < 3.66$, df = 1, all $P > 0.06$) or the reference group (all $\chi^2 < .30$, df = 1, all $P > 0.30$). Although not statistically significant, there was a marked gap in STEM retention between URM and non-URM students in the Klamath Connection group (65% vs. 77%, respectively). Nonetheless, the STEM retention for URM students in Klamath Connection remained higher than for URM students in the reference group (65% vs. 61%, respectively).

Compared to the reference group, students in the Klamath Connection earned, on average, 2.1 more units toward their major (9.8 vs. 7.7, STATS) 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 Klamath Connection students than for the reference group.

Graduation

It is of course too early to tell if the promising results described above will yield higher long term retention and graduation rates and closed gaps among student groups. However, analysis of institutional data by the Office of Institutional Effectiveness and by the Educational Advisory Board (EAB) both point toward several strong predictors of future likelihood of graduation: scores in foundational gateway science courses such as Math, Botany, and Chemistry; rates of academic probation, and the pace of units completed toward degrees. As described above, the Klamath Connection program appears to have elevated course grades, academic standing, and units earned, which may lead to improved graduation rates in the future. Time will tell. These results are promising, but it is imperative that the campus remain committed to completing this experiment and tracking students long enough to gain a better understanding of its possible longer-term impacts.

Qualitative Perceptions of Student Engagement

In addition to these formal assessments, there are many indicators that the program had a significant, positive impact on participating students, faculty and staff. Some of the students articulated this quite nicely in essays written for their Forestry 100 class:

> ""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"

Faculty also articulated multiple benefits from the program. Many noted the heightened sense of community within the students was noticeable as early the first day of class, and that this contributed to more meaningful discussion and engagement in the classroom. Faculty also noted increased understanding of campus student support services and issues facing first time HSU freshmen. Finally, many articulated the benefits of the community of practice built through the design and implementation of the curriculum.

One aspect of the program that was more challenging for the faculty was the linking of the summer eutrophication experiment into the first semester. All were enthusiastic participants, but as the course of the semester progressed we learned how challenging it was for different faculty of different specialties to develop a unified vision and collective understanding of the processes required for each to comfortably integrate the experience into their course learning objectives. However, the benefit of doing this was clear from comments obtained from the students. When asked to reflect on the experience at the end of the semester in a written essay for the FOR100 class, quite a few mentioned how the experience made them better prepared for their classes. The majority of students articulated increased understanding of the

interrelatedness of disciplines and how basic science is important for solving social and environmental issues. One student summarized this in the following statement:

> "I have always believed that the values of math and science are important, but you also grow up with the idea in your head that you are either a math person or a science person. When it comes down to environmental issues and social problems you need just about every different type of thought process there is. You need someone to help with the math, science, policies, and someone to gain community support. Knowing all of this has helped me to realize that I am not attending college to become only a biologist, I am here to gain knowledge and one day become a part of a system that works together to problem solve and make the world a better place."

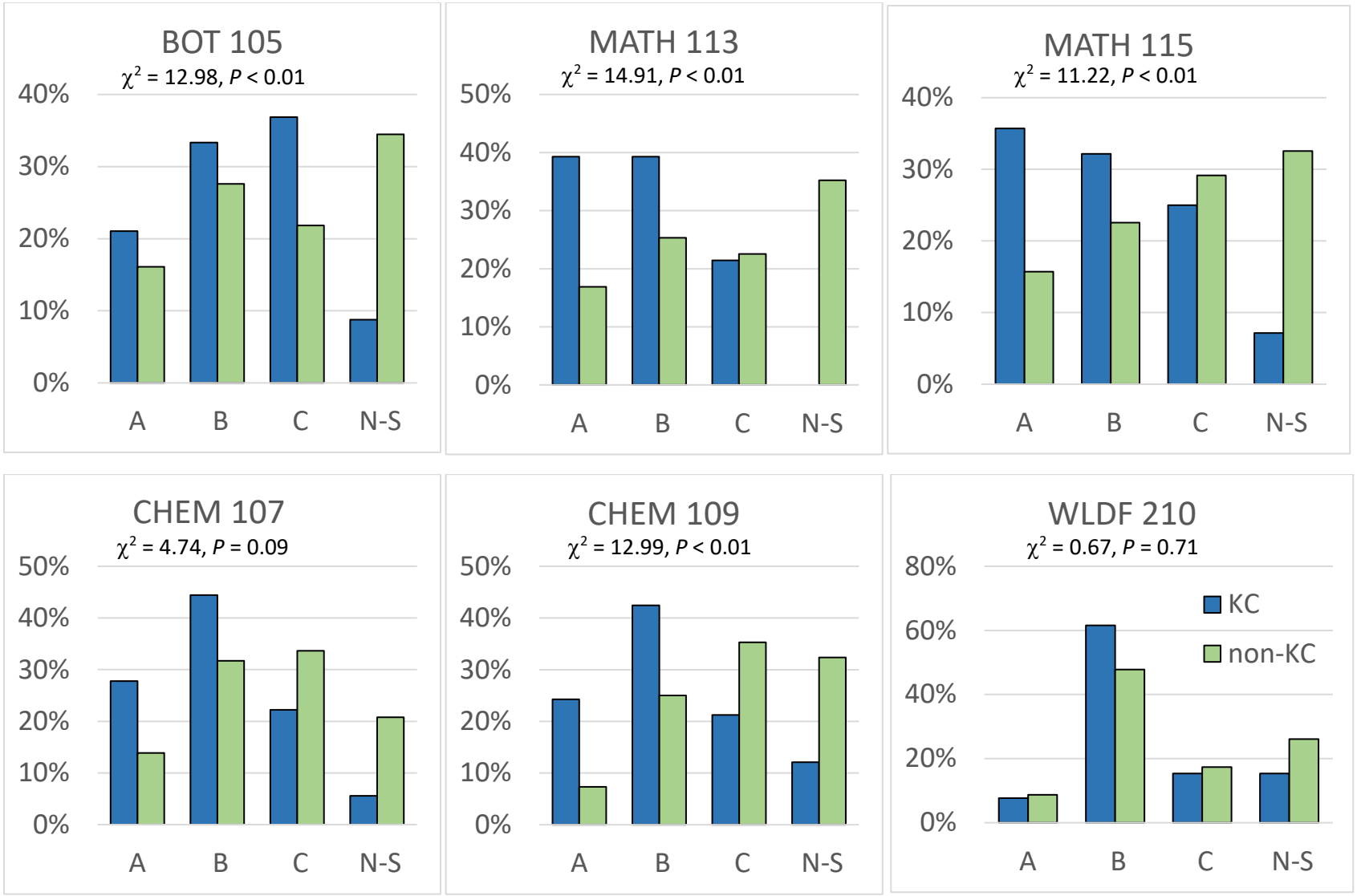

Figure 2. Grade distribution of Klamath Connection students (blue bars) and non-Klamath Connection students (green bars) in foundational and gateway science and math courses. "N-S" signifies non-success (D, F, or withdrawal). To ensure adequate cell values for χ^2 tests, grades were simplified to 3 categories: As&Bs, C or CR, and N-S, so there are 2 df for each test.

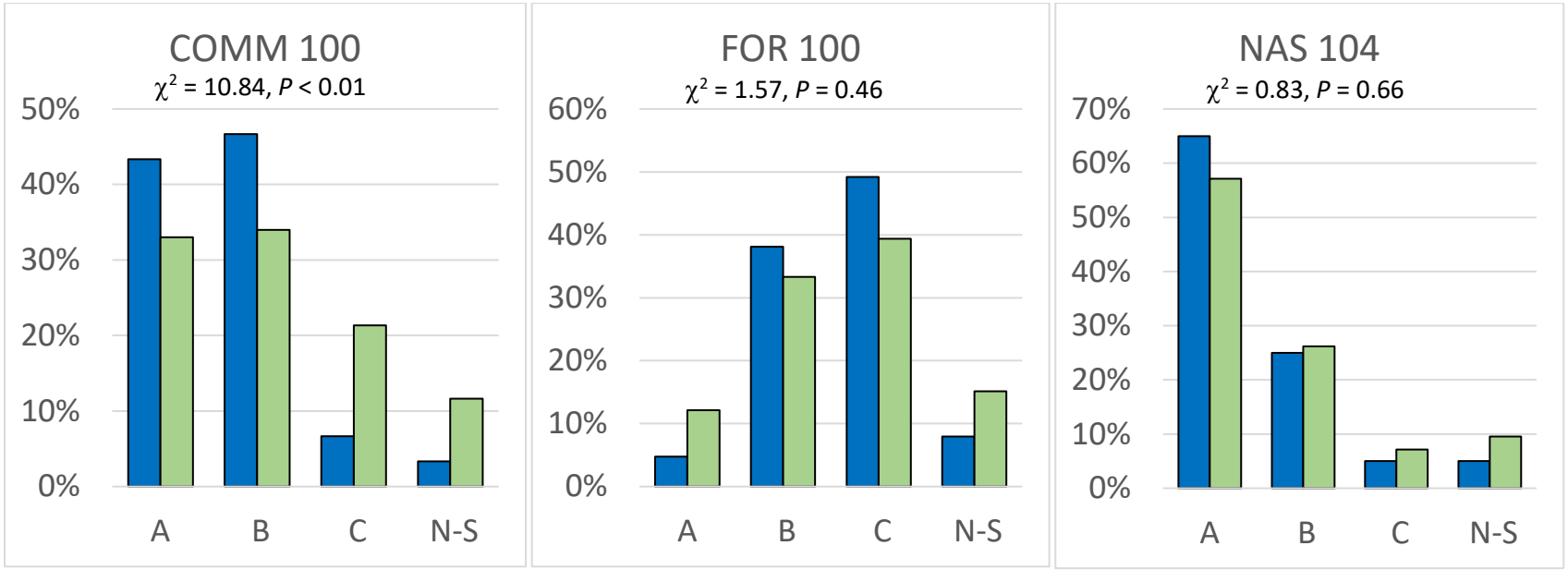

Figure 3. Grade distribution of Klamath Connection students (blue bars) and non-Klamath Connection students (green bars) in non-science General Education courses. "N-S" signifies non-success (D, F, or withdrawal). To ensure adequate cell values for χ^2 tests, grades were simplified to 3 categories: As&Bs, C or CR, and N-S, so there are 2 df for each test.

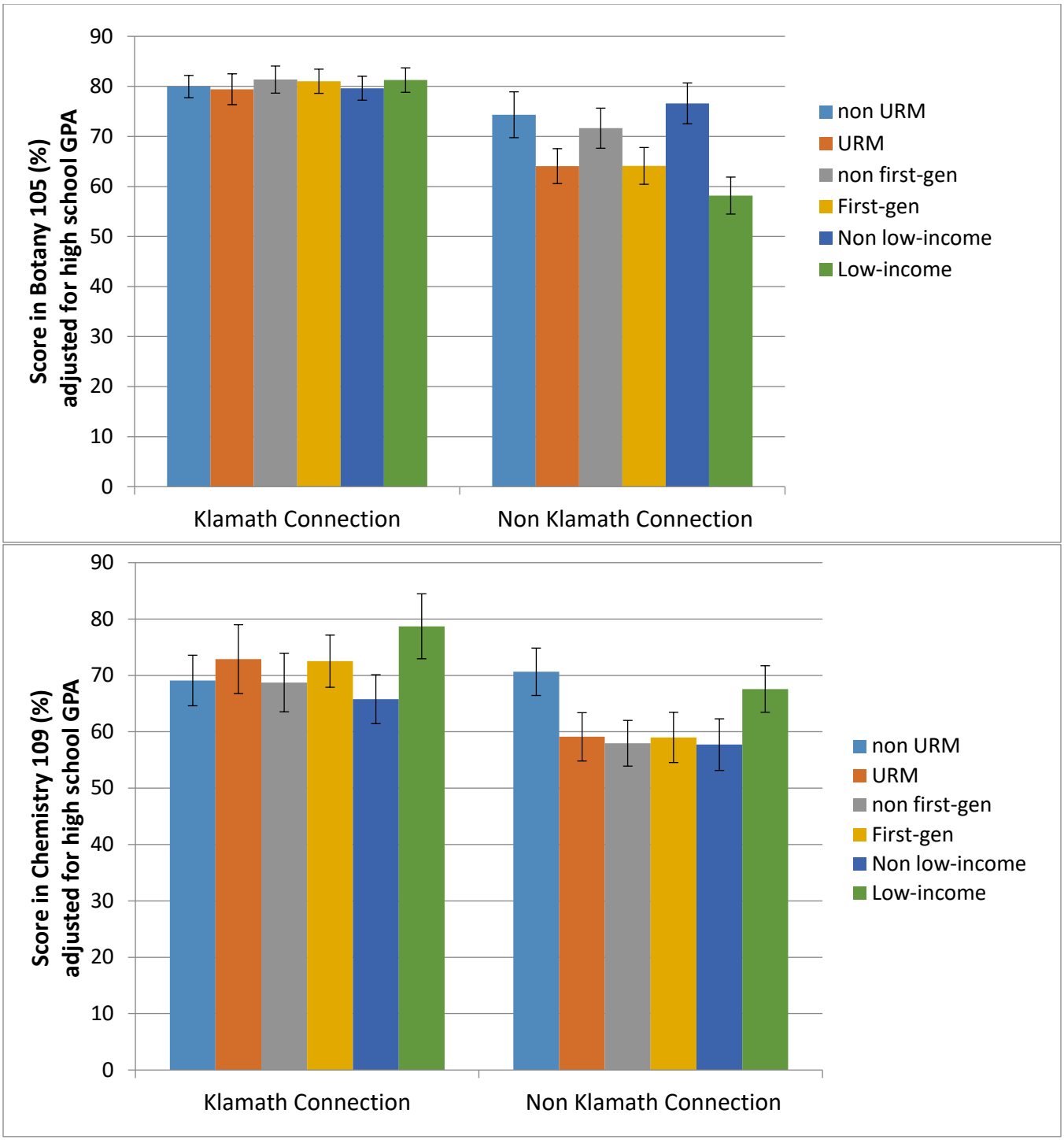

Figure 4. Percent scores of Klamath Connection and non-KC students in BOT 105 and CHEM 109. This analysis includes High School GPA as a covariate (ANCOVA) to diminish possible effects of self-selection. Values are means ± 1SE. These data are for first-time freshmen only. In Botany, KC students scored higher than non-KC students, and in several cases gaps in student performance among groups were reduced or eliminated (i.e., significant main effect of KC and some interactions with KC and student group). In Chemistry, there were few significant effects, but underrepresented students in the KC program tended to do as well or better than their counterparts. Results on raw scores (ANOVA) were qualitatively similar, and full stats are available upon request.

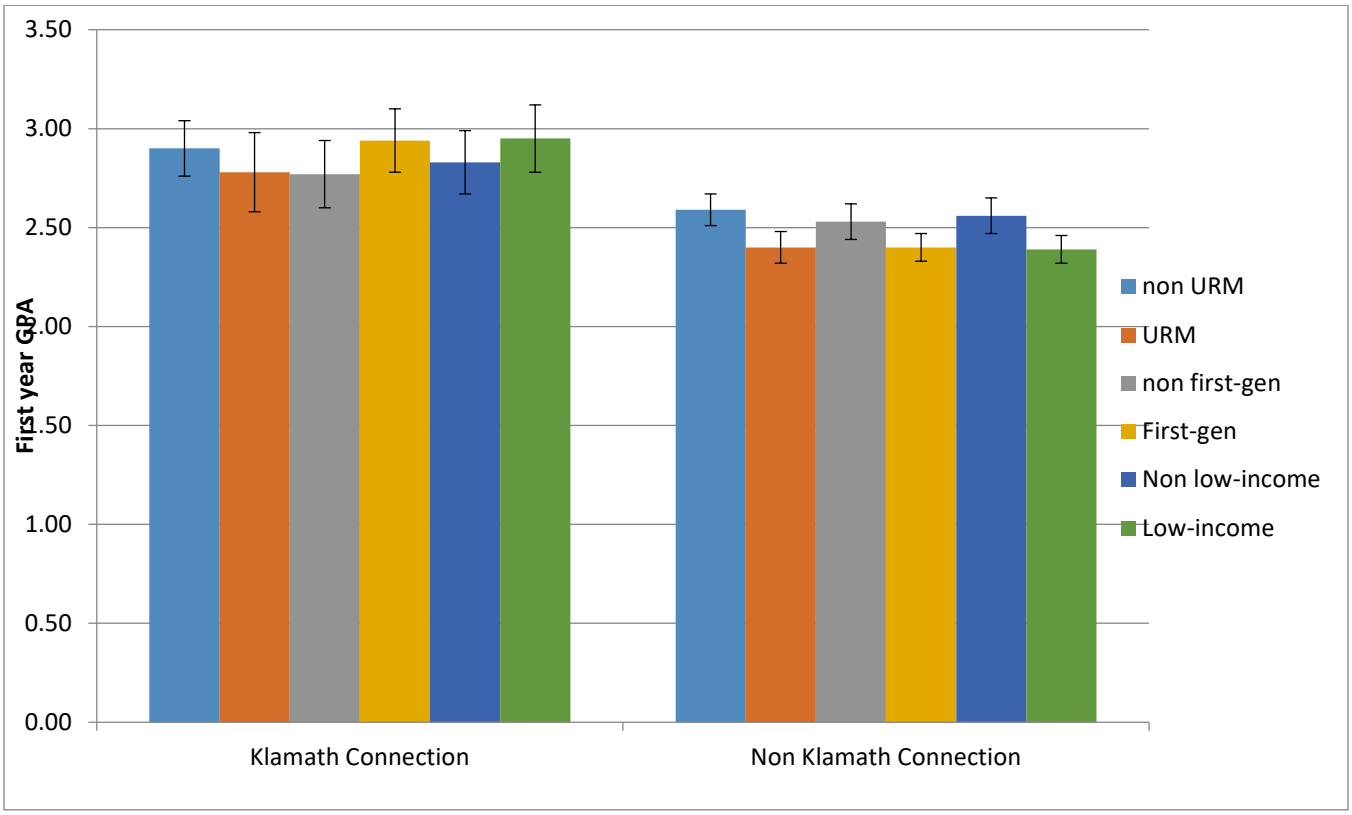

Figure 5. First year HSU GPAs for Klamath Connection and non-KC students (freshmen in the same major; aka the "reference group"). This analysis includes does not High School GPA as a covariate. Values are means ± 1SE. Analysis with HS GPA as a covariate are qualitatively similar and available upon request.

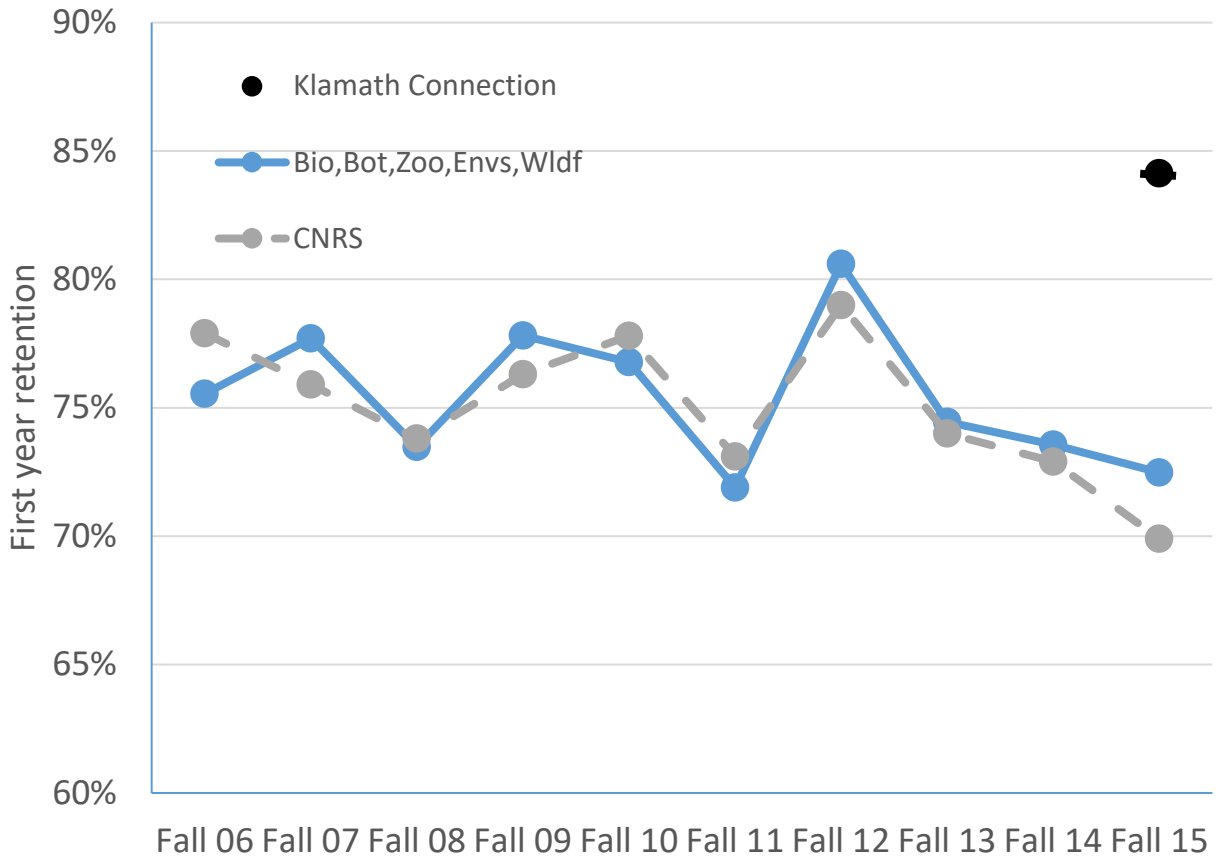

Figure 6. First year retention for first-time freshmen in the CNRS and selected majors over the last decade, contrasted with retention for the first cohort of the Klamath Connection.

Discussion

Our analysis of the first year of the Klamath Connection program suggests it has significantly improved the first year experience for entering STEM Freshmen. Students self-reported heightened sense of belonging, community, academic skills, and attitudes when compared to other freshman in their majors. They scored higher in nearly all first year core science, math and GE courses, had higher overall first year GPAs, completed more units toward their degrees, had lower rates of academic probation, and had increased retention into the sophomore year. Gaps for underrepresented minority and first-generation students almost disappeared in the first semester Botany course, and were diminished for first year GPAs, though gaps in retention for underrepresented students persisted. The initial success of this trial place-based learning community suggests it should be expanded on a trial basis and perhaps considered for institutionalization. However, there are several important caveats to consider when evaluating this trial. Also, as with any first-time experiment, there were several lessons learned, prompting several modification for the second cohort. Here, we briefly review those caveats and modifications for improvement.

Caveats and Modifications

There are two core caveats to the program's results. First, some of the differences we documented in students student performance could be partially due artefactual effects of our design. The so-called Hawthorne effect is the tendency for people to modify their behavior when they know they are being carefully watched. This phenomenon could be operating in the Klamath Connection, as students and faculty were generally aware they were part of a trial that was being monitored, and this realization could have affected their behavior in ways that led to higher student performance. Related, any change to the status quo via an institutional experiment may prompt temporary excitement and enhanced performance from both students and faculty, and these effects could diminish as the novel practices become standard. Second, despite our best analytical efforts, there could remain some possible self-selection bias. Because the Klamath Connection is currently an opt-in program, the profile of KC participants may differ from the non-KC freshmen in ways that can affect their sense of belonging, academic performance, and so on. Some of our analyses were well controlled enough to diminish effects of this bias (i.e., comparisons of scores in BOT, CHEM, and overall GPA, which all used High School GPA as a covariate), but a randomized control trial experimental design could better attribute differences in performance to a place-based learning community. As place-based learning communities continue to be explored for first-time freshmen at HSU, moving toward an opt-out model would diminish or eliminate this self-selection bias.

Our assessment of the first cohort also revealed several areas for improvement. Here, we describe three of these areas and how were have modified the practices of the second cohort in an attempt to address them.

Cohort demographics. The low representation of Hispanic/Latin@ students in the Klamath Connection program is a concern (22% vs. 42%, Klamath Connection vs. the reference group, respectively). This discrepancy was especially troublesome as Latin@ students in the program have diminished gaps in academic achievement relative to the reference group. For the second cohort, we modified our recruitment efforts to better target these students (e.g., all materials were bi-lingual and we made specific targeted calls for prospective students). Demographic results from the second cohort suggests these efforts significantly improved the demographic breakdown of the program. The percent student in Klamath Connection that are Hispanic/Latinx jumped from 22% in cohort one to 34% in cohort 2, and does differ significantly from the percentage among the reference group for AY 2016-2017 (reference for cohort 2; also at 34%). Overall, the percent of students form traditionally

underrepresented groups does not differ between the cohort 2 and the reference group (41% vs. 45%, respectively). For recruitment of the third cohort, we will continue our expanded recruiting efforts. But perhaps the simplest and most effective way to increase diversity of participants is for this program to become an "op-out" rather than an opt-in program if it becomes adopted by the university after the experimental period.

Assessing math preparedness and including students requiring single math remediation.

Our experience with cohort one of the Klamath Connection also revealed shortcomings in the university's current methods to identify the math preparedness of incoming students so they are enrolled in an appropriate first semester math course. The Klamath Connection's first year coursework includes a science class with a math prerequisite (Chem 107 or 109), and this has implications for both student registration and eligibility. To remain consistent with current HSU practices, we used the existing MDTP exam to guide student math placement, but this system does not align with the timeline required for the block scheduling. Block scheduling requires registration before HOP begins, yet currently many students do not take the MDTP until they arrive to campus and participate in HOP. To ensure the scores were received on time, extensive coordination and communication with the students by the KC Coordinator and Math department was required. This ultimately proved confusing to students, laborious for program staff, and in some cases results in suboptimal math placement. For the second cohort, we worked closely with Math Department Chair Jeff Haag and Professor Dale Oliver to implement two practices that would improve placement and allow for students requiring one semester of math remediation to participate in our program. First, with funding from Provost Alex Enyedi, we implemented the ALEKS® math placement and online training system for the second cohort. Initial results suggest this system helped ensure students took a math placement instrument in time for appropriate block enrollment, and it also helped some students improve their math preparedness over the summer. Second, we piloted a new "co-requisite" alternative to traditional math remediation for the second cohort. With this alternative, students needing single semester math remediation were enrolled in both Math 113 and Math 43 (with new content). This model has the significant advantage of not marginalizing math remediation students (they remain enrolled in Math 113 and other first year courses with non-remediation students), and it enables them to stay on track with their peers in the program. Full analysis of results of this trial are forthcoming, but initial results look promising, albeit with a very small sample size (5 of 6 students passed Math 43 and co-enrolled Math 113).

Camping vs. campus-based summer immersion. For this first cohort, 20 students participated in a camping version of the Summer Immersion, while the remaining 43 experienced the campus-based version. Based on Summer Immersion surveys, MapWorks surveys, and analysis of course grades and GPAs, we found very few significant differences between the campus-based and camping groups (GPA and first year retention rates were almost identical). The camping Summer Immersion was more expensive per-capita and it required additional planning. We also noted some envy among non-participants. Therefore, we modified our program for the second cohort so that all students participated in a campus based summer immersion. Nonetheless, authentic exposure to field work and the environments of the North Coast and Klamath Basin are important for the success of this program, and we are currently investigating models by which students can participate in a camping trip during the academic year.

Linking Content Across the curriculum. This first attempt at linking content across the curriculum. While was clunky and imperfect, but it was it was clear there were benefits for both the students and participating faculty who found it illuminating to explicitly relate "their" course content to other classes in students' were taking, the

process of communication and coordination among the participating faculty proved more challenging than expected. Feedback from faculty was used to optimize both the organization of the faculty and the curriculum and for the second cohort. With that said, multiple lines of communication were at times confusing, and we now are exploring the use of MapWorks as an electronic communication tool for the second cohort.

Future, Costs, and Scale-ability

This experimental program is based on a tapered funding model in which the CSU STEM Collaboratives grant pays for ~99% of the first cohort (63 students) and ~half of the second cohort (~120 students), with the University funding the other half. The University has committed to fully fund the third cohort (~150 students, AY 2017-2018). At that time, the University will decide how to proceed in the future.

The CSU STEM Collaboratives grant was for $375,000, and the University pledged a match of ~$255,000. Some of this funding was expended in Spring and Summer 2015 before the start of the first cohort as capacity building, including faculty wages, hiring a full-time coordinator, travel required for grant workshops and conferences, and some costs in supplies. After those start-up expenses, most funds were directed to project oversight, faculty wages for participation overload and work on non-green days, and the expenses incurred during the Summer Immersion (dorm housing and food for students plus bus expenses). Other costs, thus far borne by the college, include the WTUs necessary for the FYS sections (3 for first cohort, 5 for second cohort). Costs per student are difficult to calculate and potentially misleading due to substantial start-up costs and cost unlikely to be carried long-term, but at present they are estimated to be $2500 for cohort one, $1300 for cohort two, and $800 for cohort three. Per student costs may continue to go down with economies of scale if the number of students increases. Nonetheless, even at the liberal estimate of $800 per student, costs to place all first-time Freshmen in the college (~540) in a place-based learning community like the Klamath Connection could be in the neighborhood of $440,000.

Substantial savings could also be realized if the Summer Immersion occurred coincident with, or instead of, the traditional Humboldt Orientation Program (HOP). This change could eliminate the need to pay for additional dorm housing and food, and may lower faculty participation costs if activities occurred on regular "green" work days. Students pay an extra fee for their orientation program (currently ~$50 per student), and with a re-imagining of HOP, some of this revenue could potentially be directed to offset Summer Immersion costs.

If the concept of place-based learning communities is expanded to additional students, it will first be beneficial to cluster majors into disciplinary groups and work to align their first-year maps as much as possible (akin to the concept of "meta-majors"). For example, perhaps as few as five place-based learning communities could serve all incoming freshmen declaring majors in STEM disciplines (Table 8).

Table 8. Example place-based learning communities for the college of Natural Resources & Sciences.

Example Community Name	Associated Majors	Approx. # incoming Freshmen[1] (# in place-based learning community)
Klamath Connection Science	Env. Science, Fisheries, Forestry, Range, Wildlife	200 (160)
Klamath Connection Engineering	Env. Engineering	50 (40)
Stars to Rocks	Chemistry, Physics, Geology, Math, Comp. Sci	50 (40)
Humboldt's Current	Oceanography, Marine Biology	100 (80)
Cells and Species	Biology, Botany, Zoology	120 (100)
Total		520 (420)

[1] Based on 5-year average 2010-2015; ~80% proposed to be in place-based learning community

The campus has recently been awarded a Department of Education HSI STEM grant that will provide funds cover for (among other things) the continuation and expansion of the place-based learning communities for the next 5 years (AY 2016-17 through AY 2020-21), with plans to over time invite the participation of most or all STEM programs and raise student participation over time to ~80% of all incoming Freshmen. There is also a pending grant from the Howard Hughes Medical Institute would advance this and other efforts. Nonetheless, even in the absence of these external funds, the college could consider an incremental expansion plan to develop additional place-based learning communities.

Acknowledgements

This project was made possible by funding from CSU STEM Collaboratives project, with funding from the Helmsley Charitable Trust. We thank Drs. Dawn Digrius and Ken O'Donnell for their vision, insight, support, and encouragement. Dr. Adrianna Kezar and Elizabeth Holcombe of the University of Southern California provided valuable insight on design and assessment, and they offered expert advice and encouragement along the way. Drs. Judith Ramaley and Elizabeth Ambos also kindly offered expertise, encouragement, and sage advice about institutional change. At HSU, we benefited from steadfast support from President Lisa Rossbacher, Provosts Theo Kalikow and Alex Enyedi, Volga Koval, Peg Blake, Radha Webley, and Steve Smith and Rich Boone. HSU's Office of Admissions and the Registrar, especially Steve Ladwig, Clint Rebick, and Travis Bruner, were generous with their time and insight and enthusiastic supporters. The Office of Institutional Effectiveness was always prompt and thorough with data requests, and lent analysis insights. The HSU Sponsored Program Foundation provided efficient grant management support. The faculty and staff of the Biology, Environmental Science, and Wildlife Programs welcomed innovative change, and many eagerly jumped in to participate. Collaborators from the Yurok, Hoopa, and Karuk tribes provided scientific expertise, unique perspectives, and generously offered their time and insights to help young budding scientists. In particular, we thank the late Troy Fletcher, Thomas O'Rourke, James Gensaw, Willard Carlson, Lisa Hillman, Chook Chook Hillman, Frankie Myers, Ron Reed, Merve George Jr., as well as Christ West, Dave Hillemeir, Craig Tucker, Rocco Fiori, Mark Higley, and Kari Norgaard. And most importantly, we thank all 63 students in the "inaugural class" of the Klamath Connection program, 2015-2016.