Lessons Learned from a Summer Bridger Research Partnership Between a Community College and a University

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Mike Pitcher is the Director of Academic Technologies at the University of Texas at El Paso. He has had experience in learning in both a traditional university program as well as the new online learning model, which he utilizes in his current position consulting with faculty about the design of new learning experiences. His experience in technology and teaching started in 1993 as a student lab technician and has continued to expand and grow over the years, both technically as well as pedagogically. Currently he works in one of the most technically outstanding buildings in the region where he provides support to students, faculty, and staff in implementing technology inside and outside the classroom, researching new engineering education strategies as well as the technologies to support the 21st century classroom (online and face to face). He also has assisted both the campus as well as the local community in developing technology programs that highlight student skills development in ways that engage and attract individuals towards STEAM and STEM fields by showcasing how those skills impact the current project in real-world ways that people can understand and be involved in. As part of a university that is focused on supporting the 21st century student demographic he continues to innovate and research on how we can design new methods of learning to educate both our students and communities on how STEM and STEAM make up a large part of that vision and our future.

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Paul Hotchkin is an Associate Professor of Biology at El Paso Community College, Valle Verde Campus. He teaching majors and non-majors biology, as well as environmental science. Paul has served as the biologist for the STEMGROW program at EPCC since 2016; in this capacity, he recruits community college students interested in Ecology and Evolutionary Biology for the summer research bridge program, coordinates field trips to local nature preserves, makes professional development lessons, and helps students to build their science projects.

Lessons Learned from a Summer Bridge Research Partnership Between a Community College and a University

Summer Bridge Partnership

As part of a partnership between a local community college and university, we have established a summer bridge program that has been proceeding since summer 2017. During the last three years, it has developed and evolved becoming larger and increasingly successful; even more so than originally planned. Targeted students for our summer bridge program include students from diverse backgrounds including minorities, females and economically disadvantaged individuals.

For the past three summers, community college students have spent forty hours a week across two summer months conducting both field and laboratory research at the university with a focus on environmental sciences and engineering. Paired with graduate students and professors, the freshman-level interns have practiced graduate-level research including on-site research at several local wetlands. Various projects have been undertaken, ranging from ecological studies on topics including potentially harmful vectors like mosquitoes and ecologically critical and valuable pollinators like bees, vertebrate presence and habitat selection, and environmental water quality and its impact on both aquatic invertebrate and plant community dynamics.

Through our summer bridge program, we have created a pyramid-like synergistic effect, whereby our initial group of community college interns have advanced to being senior mentors to high school students and the future cohorts of freshman-level community college students.

Each year our students advance to the next experience level of mentorship, impacting and sharing their learning with inducted mentees in the various levels of the community of learners. This has created a spider-web effect, which has now impacted hundreds of early college high school students, community college students and both undergraduate and graduate students at the university level. All the while, the local community has been impacted positively through presentations and sharing of the education and awareness of wetlands being cataloged and reported.

Interactions between our students, parks and wildlife personnel, our local zoological society members and other community volunteers, have led to increased awareness of the importance of wetlands to our environment and health. The opportunities awarded to our minority students have additionally made an impact in our community, holistically advancing their education and career goals.

Transitioning from a Two-Year to Four-Year Institution

The need for a smoother transition between a community college and a university was identified by the principal investigators of STEMGROW, a grant that has been funded by the Department of Education's Hispanic Serving Institutions division. Specifically, the desire for students to delve into the STEM fields of environmental science and engineering and biology was found to be a key need to address. The region in which this program is being undertaken is that of a high minority, especially Hispanic community of economically disadvantaged residents. The community college in this region is by far the most preferred way for these identified students to get a start on their post-secondary pursuits. Due to financial need and better scheduling options for the working adult and childcare accommodations the community college route allows the non-traditional college student to be able to achieve higher goals (Chen, 2011)

A detriment that is seen in this scenario is that the community college student is not provided the same kind of research and mentoring opportunities that would be found in a university. Due to lack of scientific, namely biological and engineering research labs and professor-led laboratories, undergraduate students at the college are left wanting when it comes to these kinds of experiences. At the university level, undergraduate and graduate students have the ability to approach a professor and principal investigator and ask for mentorship in their research laboratory. Thus, allowing these students to pursue their own graduate and post graduate goals in this professional setting; an experience that is dire to all students wishing to become the great scientific minds of our community.

In order to rectify this situation and create a more level playing field for community college students, bridge programs have been created in various communities to allow eager individuals the stepping-stone to get into a research-led university lab. The success of these types of bridge programs is not novel, (Brad, 2017; Oakley, 2016; Silverman, 2019; Turner, 2019) however what has been established in this specific scenario is the focus on not only the students gaining an upper hand in getting into a university, but also on the type of research carried out, the focus on student intern mental and physical health, professional development for the interns, the outreach to the community and area high school and middle schools, and a major impact on area environmental health.

The principal investigators for this grant-funded program come from both the engineering and biological sciences department of the local university. Other members of the team include biological and environmental science and engineering faculty and staff at said university and biology and engineering instructors and staff at the local community college. Together, these individuals have established a summer program that recruits community college and early college high school students to participate in graduate-level research at the university in both the lab and field settings. All the while these students are led into making a positive impact on both their community and natural environment. As perfectly stated by Oakley (2016), "Maximizing the success of our transfer students demands that two-year colleges and four-year universities nurture and maintain collaborative and effective relationships. And when we extend that collaboration to the K-12 system, we begin the positive step of seeing our institutions as one educational ecosystem focused on student success, instead of three silos focused on institutional success (para. 3)."

Intern Selection Process

The process of acquiring the student interns from the community college runs from the fall to the following spring semesters prior to the summer bridge program. Recruitment during the long semesters occurs at the community college in biology courses namely the organismal, zoological, botany and environmental science classes. As of the second year of the program, recruitment has also started at the local early college high schools whose students are enrolled in community college as well. The recruitment process includes presentations done by university and community college program staff and faculty as well as former grant students from prior years of the program. Former program students share their experiences and accomplishments during these presentations. Other forms of recruitment include campus tours of the university focusing mainly on the research labs in ecology and environmental sciences, as well as field trips to the area wetlands where the bulk of the summer program research will take place.

In the early spring, applications become available for community college and early college high school students to complete. Information collected in the applications include student transcripts, recommendation letters from instructors, and a five-hundred-word essay discussing their education plans for graduate school, long-term career goals, major area, and what research areas in ecology or environmental science and engineering they are most interested in.

Once the grant team has perused the applications, interviews are set up for each applicant. The interview is led by the program management team which includes community college and university biology and environmental science personnel who ask the same ten questions to each student. The focus being on student interests, future goals, the ability and desire to work outdoors conducting field research and how the student handles stress. These interviews are a crucial component of the application process. It allows the team to not only meet the student one on one but

also get a feel for the students' behavior and true desire to be in the program and not being forced by an outside entity such as an instructor or parent. Once the interviews are complete the final ten students are notified of acceptance and given the schedule and information to attend the eight-week long summer program at the university.

Mentors

Prior to the start of the summer program, the management team forms another sort of recruitment process, that of finding the research labs and the right graduate students to act as mentors for the new student interns. Graduate mentors are chosen based on their need for financial funding, their ability to communicate and work well with others and act as a positive influence, and their research area as it relates to the ecology and environmental science program. The goal of having graduate students work as mentors is not only to benefit the student interns from the community college, but to also aid the graduate students themselves by having a student help them with their own research which can be a daunting task for your average masters and doctoral student.

The Co-PI's of the STEMGROW grant from the biology and environmental science and engineering departments play a major role in the mentor selection process. Preference is given to doctoral students who have already begun work on their dissertation research, have projects that specifically relate to the ecology and environmental health of local wetlands in our desert habitat, and the willingness and desire to act as mentors. Master's students and undergraduates that were former STEMGROW interns from prior summers are also recruited as mentors to help aid the doctoral students and university faculty, whose labs will be used, for the bulk of the research and experimentation. The idea is for each intern to have ample support ranging from near peers to graduate students to professionals in order for the interns to have a strong pillar to carry them through the very fast-paced summer experience.

Workshops are provided to each mentor in the form of EduGuide coaching sessions and forums. EduGuide, found at eduguide.org, is an online self-paced training program of at least 15-20 minute weekly activities; i) to strengthen students' core learning skills; ii) to create a personal space for building a support network of teachers and mentors; and iii) to engage in weekly activities to raise students' academic achievement in the classroom and beyond. The EduGuide program facilitates the discovery of: 1) various ways learning are connected in and outside of the classroom; 2) How to break down one's goals into simple steps for success; 3) Resources to help one to build his/her strengths to accomplish one's goals; 4) Strategies to overcome future obstacles by preparing for them now; and 5) Strong leadership skills. The program also enables students to: i) plan, look for opportunities, and measure their progress; ii) connect with teachers and other mentors to create a network of support; iii) reflect on the past to learn more about oneself and others; and iv) develop new ideas through critical thinking and questioning to become stronger each day. In effect, EduGuide seeks to develop one's mind-set, confidence, knowledge, skills,

resilience/grit, and self-control, to enhance one's personal development, understanding of the college culture and what it takes to succeed in college.

The EduGuide program is used by each STEMGROW student intern throughout the summer and evaluated on the effectiveness of both the program itself and of the mentors that act as coaches through the online platform. In this manner, each intern can get coaching and mentoring from all the graduate, undergraduate and faculty mentors over various aspects of their learning process throughout the summer.

Projects/Research Topics

Over the past three summers of this program, research topics have ranged from water and soil quality and its impact on invertebrates and vegetation, behavior of migrating avian, behavior and trapping methods of reptiles, aquatic and terrestrial invertebrate and plant surveys, wetland health and impact on plant and invertebrate communities, biodiversity in natural and restored wetlands and man-made lakes, mosquitoes and blood-borne pathogens, design of new trapping methods for insects, design of methods for cleaning and restoring bodies of water impacted by golden algae overgrowth and much more. Once again, these topics predominantly come from the dissertations and theses work of the graduate student mentors.

Programming/Professional Development

The layout of the summer program entails eight weeks of intense field and lab-based research with both graduate and university faculty mentors, professional development, social skills building, and two weeks of preparation of a professional scale poster presentation to be delivered at an end of the summer symposium. During the two summer months, student interns attend professional development workshops and work on their research and conduct field collections during a forty-hour week. Student interns are funded throughout the two summer months and are asked to not take on any other job positions or classes during this time to ensure their full focus on the program. Funding is provided through the STEMGROW grant awarded from the Department of Education's Hispanic Serving Institution's division. This funding covers student intern, graduate and undergraduate mentor and faculty summer salaries, as well as supplies such as lab and field equipment and testing kits, and transportation to the field study sites.

Professional development workshops range from setting up and using a scientific journal and creating a testable hypothesis, to communication and presentation skills, designing a professional research poster and to a newly added topic of mental and physical health as a student handling stress at school, work and home. These workshops are led primarily by the program's management team and other staff at the university. The student interns also receive

weekly informational sessions on financial aid and scholarships, graduate school procedures, other grant and fellowships opportunities available, and STEM career opportunities. The bulk of these workshops occur on the Monday of each of the eight weeks of the program. Mondays are designated professional development days in which interns meet with another bridge program focusing on biomedical research from the same community college. This collaboration allows for members of both programs to share their research experiences, provide constructive feedback on presentations, and team building. This partnership has help build new relationships and friendships amongst these student peers all with similar goals of advancing their education and achieving success toward future careers in STEM.

The rest of the week's programming is split up by days with Tuesday being a "meet with your mentor" and "prep for the field" day where students discuss field collections strategies and goals with their mentor as well as gather up field equipment and prepare any chemicals that may be needed for the following day. Wednesdays are field days where all students and mentors go to their designated field site and conduct their field methodology and collections. Finally, Thursdays and Fridays are predominantly for processing and analysis of data collected during the field day. Every other Friday afternoon is spent on campus explorations, networking and social skills building where interns and mentors partake in around-campus treks to local coffee shops, cafes, art museums and shops.

Community Engagement

Another major component of the summer bridge program is in the form of community engagement in outreach. Student interns are given a chance to participate in STEM events for children in the community. Activities include building solar ovens, programming TI calculators and rovers, water quality testing, fun chemistry activities and field trips to local wetlands. Student interns also help in designing science fair projects for children to use at their home campuses and have also contributed by acting as science fair judges at multiple regional school districts. These events take place at local elementary, middle and high schools and also at the community college and university campus. This past summer, student interns were asked to present to a group of Upward Bound high school students on their research and then provided mentoring to the high school students who share many cultural and financial backgrounds. They shared their struggles with the younger students and how they have found ways to overcome such obstacles.

Summer interns have also had an impact on the science teachers in the region. The students have been asked to return twice now as presenters at the region's largest science educators conference minCAST. The students take their own research methods in the field and lab and turn them into lessons for the science teachers who can then turn around and use them in their own classroom. Lessons such as making chemistry more relevant to everyone by testing water quality, creating and printing science models in 3D, programming TI calculators and servos to run a

recycle sorter built of 3D-printed parts, urban ecology allowing teachers and students to get out of the classroom and learn in nature and many more unique lessons created by the program's students.

Another crucial impact the summer bridge program has had on the community is in the form of aiding the environment by educating the public and finding solutions to pollution and health dangers. Several student interns have had research projects focusing on the health of the wetlands and water ways in the area including a local man-made lake. This lake is in critical danger due to golden algae blooms that have taken it over. Along with university faculty, student interns have aided in creating methods for cleaning up the lake using floating islands designed to help filter the water and add vital nutrients for plants and aquatic fauna to thrive and thus replace and neutralize the algae problem.

A positive impact on other local waterways is on the restored wetlands where most of the program's student intern research takes place. This wetland has been threatened time and time again by highway and housing construction nearby, illegal dumping and hunting on the premises, and lack of water provided by the Rio Grande and a water treatment plant that lies adjacent to the wetlands. The wetland has been managed by the university for the past four decades and is very unique due to its history and surroundings making it an ideal field site for various research topics. Student interns have designed new methods of humane and safe trapping for animals that allow for a safe release thus reducing impact on the environment. Biodiversity studies have also allowed for the discovery of new species in the area previously undocumented as well.

Finally, an impact that hits closer to home for most humans is the research that has been conducted on local disease vectors such as mosquitoes, ticks and black flies. Numerous student interns have conducted their projects through the university Mosquito Ecology and Surveillance Laboratory where they get to work alongside professors and graduate students collecting data from the community on vector presence. Students have gone out to residential and rural areas to collect this data of which has been shared with the Centers for Disease Control.

Social Aspects of the Program

An incidental impact from the program has been the social aspect that seems to have stemmed from the collaboration of student interns with each other and with the mentors they work with. Friends and hopefully life-long relationships seem to have emerged from the program, which even though still very young, has shown to be a great additional benefit. The varied group of individuals accepted every summer include minorities of different cultural and ethnic backgrounds, high school dropouts, military veterans, students with disabilities and age groups that range from teenagers to adults in their forties who have children of their own. However, one thing they all have in common is their economic struggles and the goals of being successful in STEM and becoming financially stable after achieving

their future career goals. Their love of science and research seems to be a factor that they can all share in common as well and has brought them together. Social outings have become a new component in the program that was not expected. Student interns and mentors who spend forty plus hours a week with each other have become more than just associates in the lab but also close friends outside. Students who came in very quiet, shy and even with some insecurities have found shoulders to cry on and smiles to cheer them up. The stress that can be found in every college student is shared by all but has also been something that has been alleviated by the presence of new friends and allies.

The program management team has also scheduled weekly community outings with the student interns. The city in which this all takes place is very large and spread out where student interns may be coming from areas on complete opposite sides of town from where the university is located. Another thing to take note of is that a majority of the students who attend this university do not live on the campus, most are commuters from distant parts of town and international students from Mexico. So, every Friday the entire group, student interns, mentors and managers go on walks around the downtown area near the campus. Taking trolley car rides to visit museums, coffee shops and restaurants, libraries and bookstores and community gardens. These outings have been fun for all and very educational as well. New experiences like these have also aided in getting the student interns to visit new places and meet new people as well which they may not have done on their own. The goal of these outings is to make the students aware of what is within walking distance of the campus and introduce them to places where they can study or hold study groups sessions in the future.

Symposium Participation

The culmination of the summer program comes in the form of a professional poster symposium hosted at the university. The symposium is a collaboration with two other grant-funded programs for undergraduate research, one of which is a state-wide research program. The summer bridge interns present their posters competitively amongst hundreds of students from all over the state. The three-day long event allows students to attend various workshops and meet with university and research lab personnel from other regions. This is a very rewarding event where the summer bridge students have made some valuable connections and have also won prizes for best poster as well; a major accomplishment to add to their curriculum vitae and resumes.

Post-Summer Learning & Growing

Once the summer has concluded and student interns have presented their final findings at the symposium, the program does not end. Many of the student interns have been hired as peer leaders and mentors to future program students and as teaching assistants and tutors at both the community college and university. Several of them will

have transferred to the university at this point and their roles are a little different in that now their focus is on their class studies and also as acting mentors in university biological and environmental science and engineering courses. They work alongside the graduate student teaching assistants in creating lessons, tutoring, and aiding in field trips. The courses that the students act as peer leader/mentors in include both invertebrate and vertebrate zoology, botany, introduction to biology, and intro to environmental science. Field trips are established in each of these courses with the now peer leaders demonstrating field collection methods and aiding students to create their own research projects and posters for the course. The peer leaders may continue to work for the program all the way through to their graduation. As of the writing of this paper, four students from the first year of the grant have graduated and two have moved on to graduate school at this university and two have entered their careers in environmental science and engineering.

Other activities that the former summer bridge student interns carry out during the spring and fall semesters include research in the university labs, internships in other research programs, more community outreach, recruitment for the program and assisting program managers in social media and website design and maintenance.

Many of the students have been accepted into the labs they started their research in during the summer program as well. This has led to many of them getting to travel to symposiums and conventions across the country sharing their research. The opportunity for these current community college freshmen and sophomores to continue to work in the professor-lead research labs is almost unheard of. The types of students that usually gain this role are graduate students, not undergraduate and certainly not current community college or early college high school students. This chance to leap over current university undergraduates and join the ranks of doctoral students is in itself a major accomplishment. It allows them to further their research experience and network for their future educational goals and careers.

Former interns have also gone on to be accepted into other internship programs, some of which are out of state such as the Clean Energy Summer Internship with the NRDC and with the Doris Duke Conservation Scholars at the University of Washington. Others have received funding to continue in a student research position at the university through new programs like RISE Scholars, COURI and LSAMP that ensure a transition to graduate school. Again, an opportunity not easily gained by a non-university student.

The former interns that continue to be hired by this program also continue to make an impact on their community. They act as judges at several local science fairs for elementary, middle and high schools. They also have become mentors to unprivileged minority high school students from all over the city showing them that they can also achieve their dreams and goals of becoming scientists. Field trips to the local wetlands and to the university provide the

younger students a chance to see the types of research they could also do and the ways they could help out their community.

Another impact on the community that has arisen from this program is the group of students who have joined a university environmental science and engineering professor and her attempts at getting clean water to local *colonias* found in the United States and bordering Mexico. These *colonias* are low-income, unincorporated communities of families that find themselves living in substandard housing, oftentimes lacking in basic services. Because of this sort of inhabitation, there is no formal plumbing with clean municipal water brought to them. Instead, these families are forced to use water from water tanks that are not maintained and wells that are not tested or treated properly for human consumption. To aid in this dilemma, the university professor along with the help of the grant's funding and students can install water filters in the homes and help to treat the water found in the tanks. They also educate these families on proper water treatment and maintenance of the water filtration systems so they can continue to use them on their own.

Program Success and Evaluation

STEMGROW Program activities have been closely monitored and evaluated, not only to determine their effectiveness, but also to facilitate continuing improvement of the strategies. Pre and post surveys have been conducted each summer in order to get a better picture of overall gains and needs for the program. Among the major evaluation efforts of the program were the assessment of the following: i) Summer Experiences from the Research-Driven/Project-Based Program and ii) EduGuide and overall Program Impact/Effectiveness

i) Summer Experiences from the Research-Driven/Project-Based Program

The summer bridge program has provided enrichment for STEMGROW students from the community college. The program sought to enhance students' skills and knowledge about experimental research design, hypotheses formulation and testing, data collection, statistical analyses and reporting, as well as wetland biota and water quality, soil quality, wetland flora and function, invertebrate sampling and identification, and the use of field and lab equipment. Overall gains from each of the three years can be seen in seen in Figures 1-5. Figure 4 for example, shows that during 2017, areas where significant proportions of the students made *more than moderate to big gains* included: Using new field and lab equipment (88%); Experimental design (75%); Collecting & organizing data (75%); Wetland function (75%); Wetland biota and water quality (63%); Invertebrate sampling and identification (63%); Hypotheses formulation and testing (50%); and Wetland flora (50%). As seen in Figure 5, most of the students rated the following elements of their research experience as *Very Good/Excellent*: Communicating ideas effectively in writing and presentations (75%); Completing interdisciplinary research (75%);

Conducting experiments (63%); Processing and organizing experimental data (63%); Solving problems related to the environment (63%); Effective participation in a team (63%); and Analyses of experimental data (50%).

In the second year, 2018, the objectives targeted were: i) the enhancement of students' skills in and knowledge about experimental research design, data collection, statistical analyses, report writing, and use of field and lab equipment; and ii) the improvement of students' interest in science and confidence in their ability to do well in science. Figure 1 shows research areas in which significant proportions of the students made *more than moderate to big gains* included: Problem Solving in general (100%); Formulating a research question that could be answered with data (100%); Identifying limitations of research methods and designs (100%); Figuring out the next step in a research project (90%); Understanding the connections among scientific disciplines (90%); and Analyzing data for patterns (70%). Other skill-enhancement areas in which significant proportions of the students made *more than moderate to big gains* shown in Figure 3, included: Managing time (100%); Conducting database or internet searches (90%); Writing scientific reports or papers (80%); Defending an argument when asked research-related questions (80%); Understanding journal articles (80%); and Calibrating instruments needed for measurement (70%). Confidence/Attitude areas, seen in Figure 2, in which significant proportions of the students made *more than moderate to big gains* included: Confidence in their ability to contribute to science (100%); Confidence in their ability to do well in future science courses (100%); Ability to work independently (100%); Understanding what everyday research work is like (100%); Comfort in discussing scientific concepts with others (90%); and Taking greater care in conducting procedures in the lab or field (90%). Furthermore, a significant proportion of the students (70%) *Strongly Agreed/Believed* that: their participation in the summer research confirmed their interest in their science field of study, and that the experience had clarified for them which science field of study they would pursue.

In the third year, 2019, research areas in which 100% of the students achieved *Good/Great Gains* shown in Figure 1, included: Problem Solving in general; Formulating a research question that could be answered with data; Identifying limitations of research methods and designs; Figuring out the next step in a research project; Understanding the connections among scientific disciplines; Analyzing data for patterns; Other skill-enhancement areas in which significant proportions of the students achieved *Good/Great Gains* shown in Figure 3, included: Managing time (100%); Conducting database or internet searches (100%); Writing scientific reports or papers (70%); Defending an argument when asked research-related questions (90%); Understanding journal articles (90%); Using statistics to analyze data (80%); and Calibrating instruments needed for measurement (70%). Confidence/Attitude areas in which significant proportions (90-100%) of the students achieved *Good/Great Gains* shown in Figure 2, included: Confidence in their ability to contribute to science (100%); Confidence in their ability to do well in future science courses (100%); Ability to work independently (100%); Understanding what everyday research work is like (100%); Comfort in discussing scientific concepts with others (100%); and Taking greater care in conducting procedures in the lab or field (90%). Furthermore, a significant proportion of the

students: (60-70%) Strongly Agreed/Believed that: their participation in the summer research confirmed their interest in their science field of study; and that the experience has not only clarified for them which science field of study they would pursue, but also has prepared them for advanced course work. Lastly, a significant proportion (60-100%) of the students expressed that their aspirations have been strengthened by the summer program, and that they were *Much More Likely/Extremely More Likely* to: Enroll in a PhD program in science, mathematics, or engineering (60%); Enroll in a Master's program in science, mathematics, or engineering (100%); and Pursue work in a science lab (90%).

Figure 1. Perceived Gains as a Result of Participation in Research-Driven Lab/Course (2017-19)

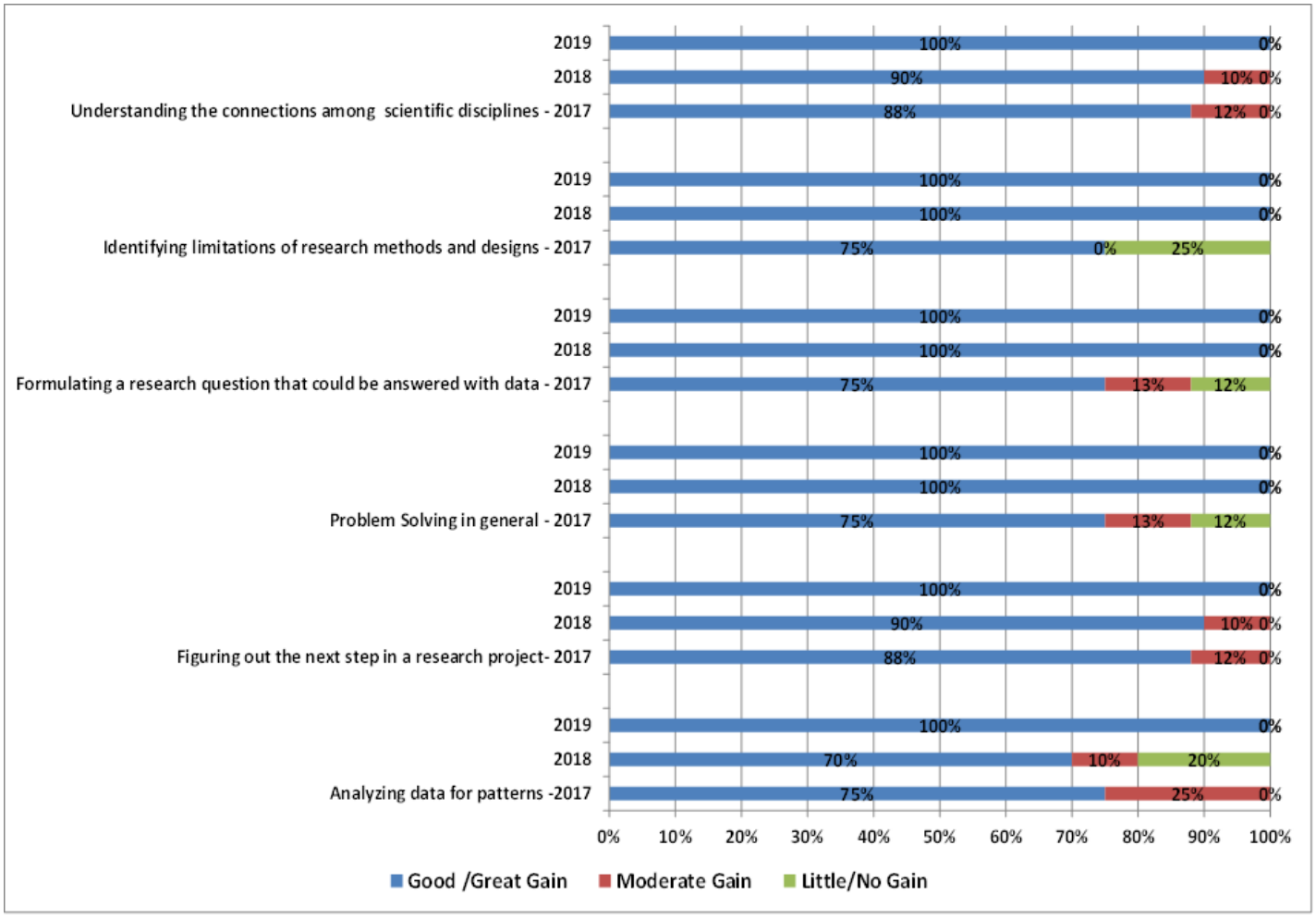
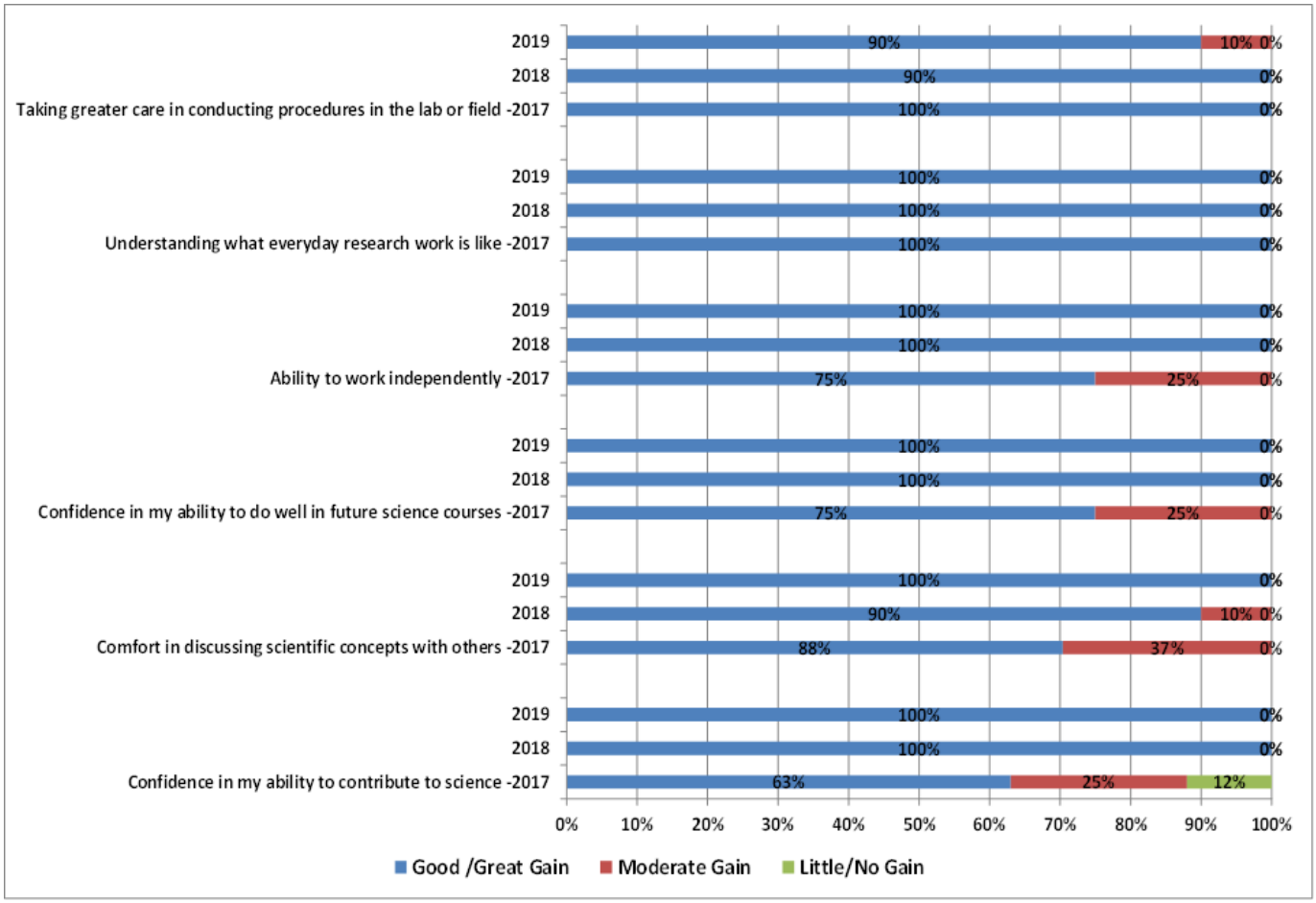
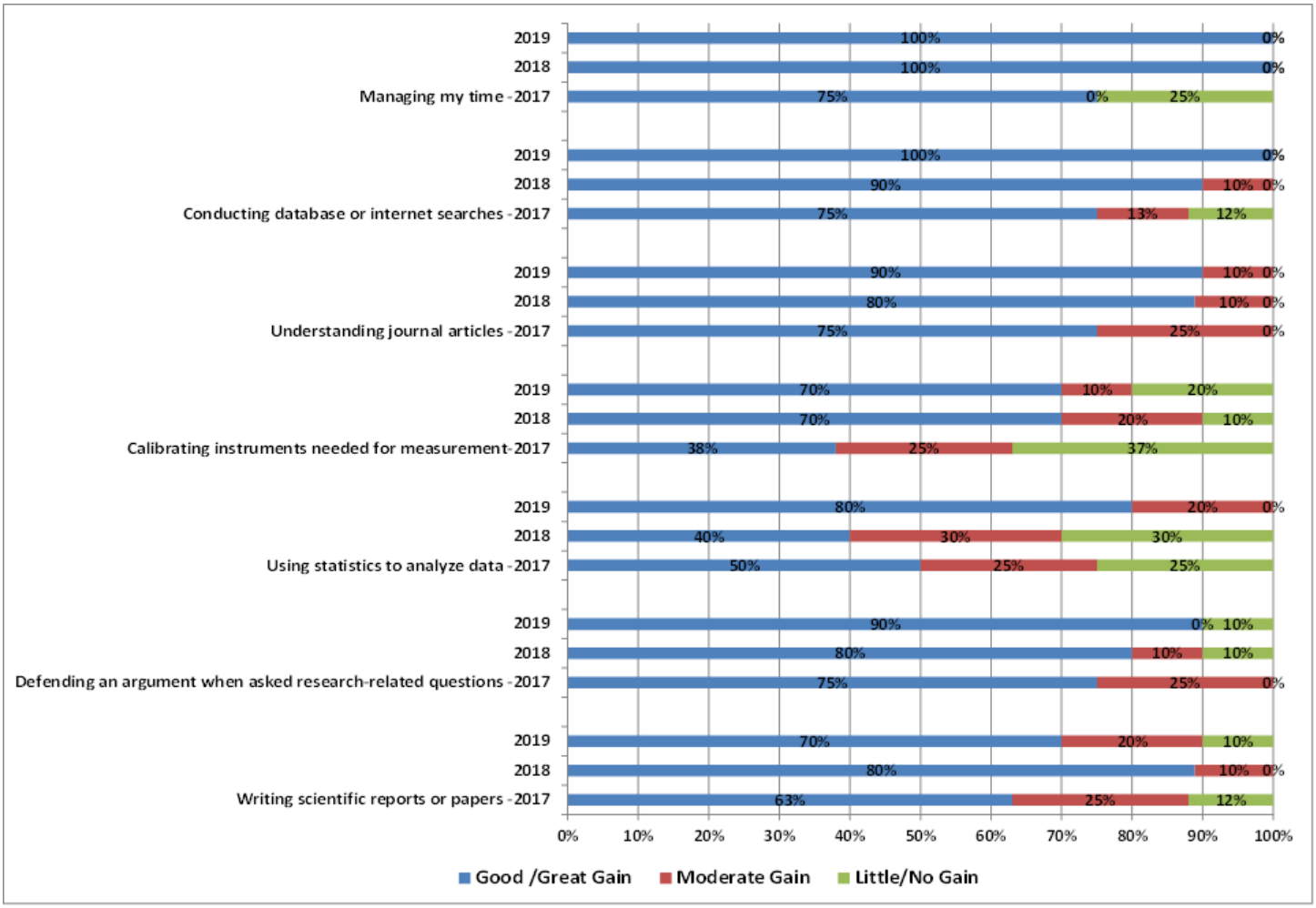


Figure 2. Perceived Gains in Knowledge and Skills as a Result of Participation in Research-Driven Lab/Course (2017-19)



Major gains were seen in overall experimental design and research and wetland knowledge. Areas of particular interest are use of new field and lab equipment where student interns have had opportunities to use equipment and sampling techniques that would not have been provided to them if not in one of the faculty-led research labs. Oral and written communication skills also showed great improvement for students; most likely due to the continued presentations students gave throughout the duration of the program and of course in their final symposium. Moderate gains were also seen in statistical applications which is something that has been noted and will be addressed with further emphasis in the successive years. Most of the student interns had not had a statistics course at the community college and therefore their statistical analysis of their data was a major learning curve. Graduate student mentors played a great role in teaching the basics of statistics and giving each of their mentee students help in their own data analysis. Future program years will attempt to provide crash courses in statistics as it relates to data collection.

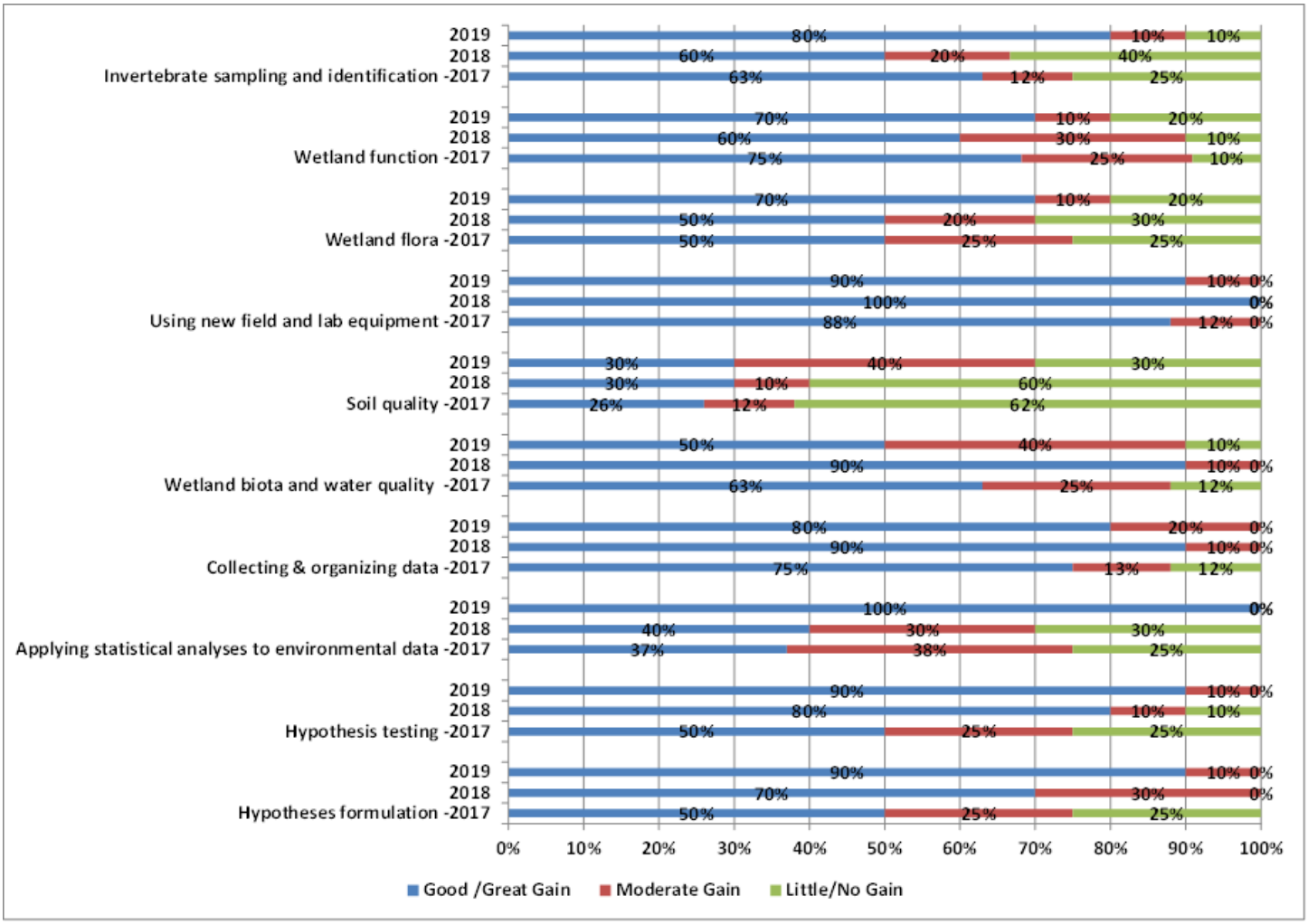
Figure 3. Perceived Gains in Knowledge and Skills as a Result of Participation in Research-Driven Lab/Course (2017-19)



i) EduGuide and Overall Program Impact/Effectiveness

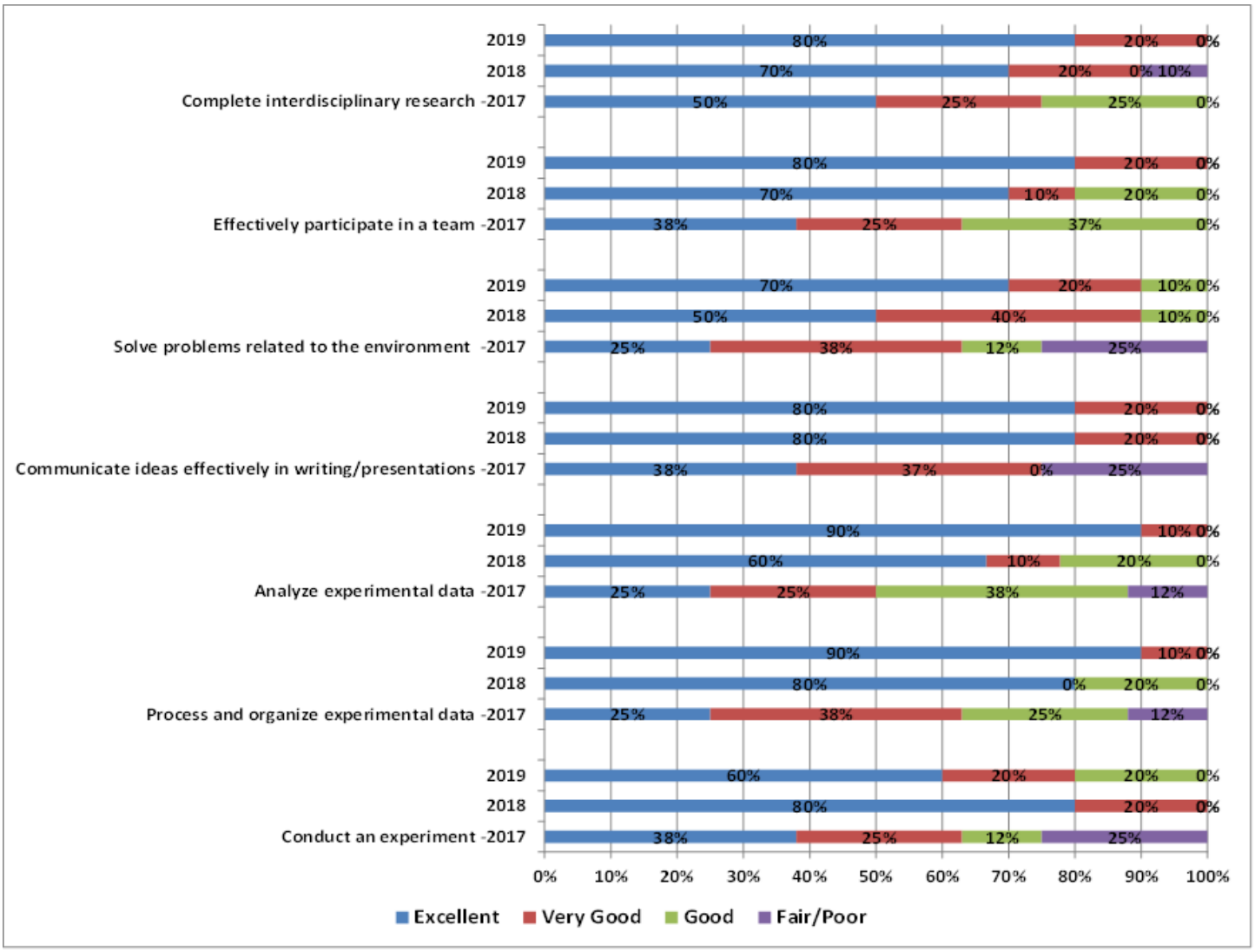
In the Summer of 2017, STEMGROW program's Cohort-1 students were evaluated with an EduGuide Questionnaire, which showed the substantive impact of STEMGROW strategies, especially the EduGuide program. A significant majority of the STEMGROW Cohort 1 students indicated they had experienced considerable growth that they attributed directly to the EduGuide strategies. The following were the major findings: On average, 41% of the Cohort-1 students indicated they had experienced Considerable/Very Considerable growth in the 14 growth areas targeted by EduGuide. Eight (8) of the 14 EduGuide targeted growth areas, with higher than 41% of the students attributing Considerable/Very growth to EduGuide were the following: Better Attendance (43%); Improved Relationships (43%); Encourage and Mentor Others more (43%); Happier (43%); Complete more Schoolwork (46%); Listen Better to Feedback (46%); Get over Setbacks Quicker (46%); and More Curious to Learn New Things (47%).

Figure 4 (Biology Course): Perceived Areas of Gains as a Result of Participation in Summer Program (2017-2019)



Student comments on EduGuide that further demonstrated the impact of EduGuide included the following representative sample of observations: “It has helped me to realize that anyone can do or become anything, all we need is more commitment”; “I am more open to constructive criticism and I manage my time and stress better than I did before. I am also more confident in approaching people”; “Helped me stay motivated and focused on what is important”; “I’ve learned to better cope with situations and not become as stressed”; “It helped me stay on track”; “It helped me to reflect on what I have overcome. It has also motivated me to keep trying and help others along the way”; “It has helped me to improve my relationship with my mother”; “It has helped me to improve my relationship with my mother”; and “I have become more optimistic and motivated me to work harder for what I want.”

Figure 5 (Biology Course): Student Perceptual Assessments of the Value/Usefulness of Activities (2017-2019)



In Summer 2018, STEMGROW program's Cohort-2 students were evaluated with the EduGuide Questionnaire; and, once again showed the increasing effectiveness of STEMGROW Program's EduGuide strategies. A significant majority of the STEMGROW Cohort 2 students again indicated they had experienced considerable growth that they attributed directly to the EduGuide strategies. Indeed, the proportions of Cohort-2 students who attributed the growth they had experienced to EduGuide strategies were higher than those of the previous year cohort (i.e. Cohort 1). The following were the major findings: On average, 51% of the Cohort-1 students indicated they had experienced Considerable/Very Considerable growth in the 14 growth areas targeted by EduGuide. Fourteen (14) of the 14 EduGuide targeted growth areas, with higher than 41% of the students attributing Considerable/Very growth to EduGuide were: Better Attendance (55%); Improved Relationships (45%); Encourage and Mentor Others more (55%); Happier (45%); Complete more Schoolwork (50%); Listen Better to Feedback (55%); Get over Setbacks

Quicker (50%); and More Curious to Learn New Things (59%); Participate more in Class (53%); Enjoy Learning more (52%); More Self-motivated (48%); More Prepared for Class (50%); Better Grades (45%); and Manage Stress Better (45%).

Student Successes

There are several student success stories that have been written since the start of this program. Students who have gone on to graduate school, STEM careers and internships have already been mentioned. Other examples are the professional conferences that many of the students have attended and presented at including the Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) for two years in a row now. Funding has been provided by the grant for these students to attend where awards have been received by some of the students after presenting their posters. The program has also been presented by former summer bridge students at Union College's Liberal Arts and Engineering conference, the Ecological Society of America SEEDS program for minorities, the Association for the Sciences of Limnology and Oceanography (ASLO) and at regional ASEE conferences. Many more conferences and presentations are in the works as well.

Lessons Learned

When all is said and done, there are still many lessons to be learned and changes that need to be made to this young and growing program. After three years of summer bridge internships, many changes have already been made. Professional development of the student interns has been modified every year as well as scheduling of workshops. Surveys conducted at the end of each summer help to identify what worked and what needed help. For instance, several students have stressed how they really needed more time when creating their final posters. Because the eight weeks go by so quickly, there is a need for a fast pace that many students have understandably struggled to maintain. Therefore, instead of introducing the poster creation component during the last two weeks of the program, the posters are addressed at the very beginning and students are to assemble them piece by piece as they go through the summer. For example, they start research on their topics immediately and are able to address the background information needed to establish a reasonable question and observation and a testable hypothesis early on. Also, during the weekly joint sessions with the partnering biomedical bridge program, students present each portion of their poster as it comes about. They can then receive constructive feedback on what needs to be altered and improved. By the time their research is complete, and their data has been analyzed, they have already presented to the larger group a good number of times thus aiding them in their presentation skills as well as improving their final poster components.

One professional development component that will be added this next coming year, year four, will be a workshop on stress and counseling. Every year since its fruition, there have been instances of students being overwhelmed with stress. College students very often face stress in their daily lives when it comes to courses, exams, projects and even relationships they've built in their time at college. What has been seen with this summer program, however, is a higher degree of stress for some of the individuals. Most likely due to the fast pace of the program, the time that is spent in the lab and in the field at forty hours per week and working with new people and their own unique personalities and work ethic that may not mesh with their own. For example, some student mentor pairings have not been ideal. Personality clash can be a problem for some students that are more sensitive than others. So, changes in mentors have been made mid program for a couple of students. These changes did work out much better in the end but was still a challenge to face.

In order to help with the stress that arises during the program, the new workshops are being developed that will teach the students new methods for dealing with stress. Mental and physical health components will be addressed with focus on the importance of healthy nutrition, exercise and meditation. The university counseling department will also present and provide information for students to help them as well. The topic of stress is also addressed in the interview process to get an idea of how each candidate is able to handle stressful situations. This will hopefully aid in selecting the students and placing them in certain research labs with the varying personalities and work ethics of the professors in charge of the labs and the graduate student mentors.

Next Steps and Final Remarks

Due to the success of this summer bridge program, an equivalent program under the engineering and math departments with a focus on fields other that environmental science would be a great addition to the overall grant. Since a successful format has already been established after these first three years, a new discipline-based summer research program could easily be created.

These first three years of the summer bridge program designed to aid in the transfer of community college students to the university level in STEM has been a real adventure. Many lives have changed for the better, new goals have been established and new friendships have been made. A positive impact on the community as a whole and the environment of the local desert wetlands and lake has been made as well. The spider web effect of spreading out to so many different individuals from all ages and cultural and educational backgrounds as well as the impact on the environment and a new generation of awareness of our environment is evident throughout the whole program. So much can be learned from this experience and since it is still such a young program, so much more will be accomplished over the next few years as well.

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