INCREASING DIVERSITY IN STEM:

Promising Practices for Postsecondary STEM Grantees

Photo courtesy of OHSU

Chazya Clements, Sona Hodaie, and Genevieve Schaack
Student Capstone Project
University of Oregon
June, 2017

UNIVERSITY OF OREGON

UNIVERSITY OF OREGON
School of Architecture and Allied Arts

PPPM
Department of Planning, Public Policy and Management
School of Architecture and Allied Arts

Table of Contents

EXECUTIVE SUMMARY

This qualitative study examines the impact of the Oregon HB 3072 postsecondary STEM Grant, a competitive grant dispersed by the Higher Education Coordinating Commission (HECC). Three of the nine higher education institutions that were awarded funds for the 2016-2017 school year were selected for this study: Chemeketa Community College, Oregon Institute of Technology, and Oregon Health and Science University. The study seeks to answer four questions: **(1) What are the promising practices to recruit and retain women and minorities in STEM? (2) What are the impacts of these promising practices on students? (3) What are the challenges that programs face in achieving their goals? (4) What are the future directions of these programs?**

We engaged 27 study participants through interviews, focus groups, and an email survey. We gathered stories from students, teaching faculty, and program administrators at the three institutions studied. The stories that we collected highlight how the programs benefit students in terms of recruitment, accessing resources, exploring academic and career potentials, and building persistence and resilience. Our research identifies promising practices and challenges that individual sites faced, and also aspects that were shared across the three sites.

PROMISING PRACTICES

- Guiding students through bureaucratic systems such as college applications and registering for classes as students often feel overwhelmed by these processes and need help advocating for themselves on an institutional level.

- Providing peer mentorship with older students from diverse communities who serve as models for incoming students in STEM programs.

- Allowing students to take college courses ahead of time, sometimes with a mentor, as a preview of the STEM degree programs to come.

- Interacting with STEM professors and professionals at science fairs is a powerful means to help students envision themselves as future STEM professionals.

    - Students stated this experience would be even more impactful if the professionals with whom they meet are also from diverse communities.

- Reaching out to students via text messages and social media in addition to traditional emails.

CHALLENGES

- Grant timeline was insufficient to fully implement new programs at the sites.
- Sites that started new programs had trouble with timely hiring of coordinators and student tutors and mentors.
- Insufficient volunteers from diverse communities to serve as mentors.
- Students report a lack of pre-enrollment information about program offerings.
- Trouble tracking students once they graduate high school.
- STEM grant funding expires on June 30, and there is no guarantee of future funding.

STUDENT STORIES

- One student, who engaged in Oregon Tech's summer program, reached out to program administration and expressed "If this program didn't exist I would have never been able to have the opportunity to come on a college campus. This means a tremendous amount to me as a high school student to have this type of experience."
- At Chemeketa, one student, the first in her immediate family to attend college, talked about the desire to be a role model, to show that women, particularly women of color, belong in STEM majors and ultimately STEM careers. Another shared that this programming helped her feel like "...I am doing the right thing at the right time, and I am not missing anything."
- A high school senior who participated in OHSU's *On Track* clinical shadow experience said, "This really helped me. I always said that I wanted to be a doctor, but this gave me the confidence that, for sure, I love this. This where I see myself, and I want to go on to pediatrics." This exemplifies how this program helps build students' identities as STEM professionals.

Although the three studied programs used a diverse range of strategies to serve students, growing students' persistence and resilience was universal among them all. The ultimate result of these programs is building students' belief in themselves as their own true resources. Students are reminded that they are truly capable and intelligent enough to pave their own pathways to college and careers that are rewarding, challenging, and fulfilling.

INCREASING DIVERSITY IN STEM:
Promising Practices for Postsecondary Support Grantees

This report details the qualitative study completed in June, 2017 as a Capstone Final Project for three University of Oregon graduate students. The study focuses on collecting stories from those impacted by postsecondary STEM grant funding administered by HECC. The HB 3072 postsecondary STEM grant, a competitive funding opportunity, was awarded to nine higher education institutions across the state of Oregon. Of those nine, this study focuses on three: Chemeketa Community College, Oregon Institute of Technology, and Oregon Health and Sciences University. Please see Appendix B for a full literature review and problem analysis.

RESEARCH QUESTIONS

This report was conducted alongside HECC's receipt of mid-progress reports from grantees. While the information received in the mid-progress reports provided details on the effectiveness of each program in reaching its goals, the human impact of grant funding was left unknown. To fill this gap, our research team developed the following research questions to examine the stories of those impacted by grant funding:

1. What are the promising practices to recruit and retain women and minorities in STEM?

2. What are the impacts of these promising practices on students?

3. What are the challenges that programs face in achieving their goals?

4. What are the future directions of these programs?

DATA COLLECTION PROCESS

Our directive from HECC was to further investigate the student level impacts of this postsecondary STEM grant's implementation. To do this, we sought to capture the breadth of the institutions' efforts and the students' experiences. We narrowed our research focus to three institutions that represented a cross-section with regard to size, urban and rural, program offerings, and degree outcomes in addition to the program life-cycle phase at the time of grant funding. We selected one community college, one technical college, and one public university - Chemeketa Community College (Chemeketa), Oregon Institute of Technology (Oregon Tech), and Oregon Health and Science University (OHSU).

- OHSU's *On Track OHSU!* program has been in place since 2013 and is aimed at increasing women and minority participation in STEM degrees;
- Oregon Tech's *High School Transfer* program was a developed program, but it did not previously have an emphasis on supporting female and minority students in STEM fields;

- Chemeketa's *U-STEM* program was created as a result of grant funding.

These three sites demonstrate the impact of grant funding on differing program life cycles. Our case studies of these three programs reveals the promising practices for recruitment and retention of female and minority students as well as the challenges experienced. Please see Appendix A for more information about site selection.

METHODOLOGY

The varied nature of the institutions and grant-funded programs affected the number and roles of participants recruited from each site. We spoke with those responsible for procuring, administering and implementing the grant as well as with student participants in grant-funded programs. A total of 27 participants were involved in this study.

Our research was conducted over the course of six weeks in the spring of 2017 through in-person and, when necessary, over-the-phone interviews. In the case of OHSU, a brief, open-ended survey was administered to student tutor/advisors. We asked open-ended, narrative questions to participants in order to develop a clear understanding of program offerings and effects of program support on student recruitment and retention.

ANALYSIS

HECC received mid-progress reports from grantees that allows for evaluation of effectiveness for each program in achieving their goals as listed in their initial grant applications. To avoid redundantly analyzing the measured achievement of programs, this study complements these mid-progress reports by investigating the stories of those impacted by grant implementation. Our research took a case study approach, hoping to capture the programmatic breadth of the grant implementation at each of the three institutions. In determining the impact of grant funding across institutions, we analyzed the following:

- **Impact of Grant Funding:** What has been the impact of grant funding?
- **Promising Practices:** What have been effective strategies for the program?
- **Challenges Faced:** What challenges were faced in implementation of grant funds?
- **Future Directions:** How will the program continue to operate after funding ends?
- **Stories of Impact:** How have underrepresented students been affected?

CASE STUDIES

OREGON INSTITUTE OF TECHNOLOGY: *GHST*

Photo Courtesy of OIT

Oregon Institute of Technology (Oregon Tech) was granted $184,960 for the one-year 2016-17 cycle to fund the expansion of the *High School Transition (HST)* program. This program allows high school students to participate in Oregon Tech college level courses, preferably for dual credit if accepted by students' high schools. Grant funding allowed Oregon Tech to introduce an additional aspect of the program, called *Guided STEM High School Transition (GHST)*, which focuses on the preferential recruitment of underserved and underrepresented students into Oregon Tech college level STEM courses. Oregon Tech defines underserved and underrepresented students as students who are racial minorities, women, rural, first-generation college students, or socio-economically disadvantaged.

IMPACT OF GRANT FUNDING

Oregon Tech's *GHST* program offered after school and summer STEM courses during Summer 2016 at the Wilsonville campus and Summer and Winter 2016-17 at the Klamath Falls campus. As a result of grant funding, *GHST* was able to:

- Serve a total of 117 students.
- Hire a pre-college coordinator to provide personalized advising.
- Cover teaching faculty compensation costs.
- Offer courses at no cost to socio-economically disadvantaged students.
- Enable rural and geographically distant students to attend courses by offering travel stipends.
- Collaborate with regional high school partners to recruit underserved students.
- Host events to support academic transitions (e.g. completing college applications).

- Contact students using Oregon Tech's peer texting program.
- Provide food for all-day classes.

CASE STUDY INTERVIEWS

- Participants interviewed for this case study include[1]:
- Academic Partnerships Coordinator (Wilsonville campus)
- Pre-College Coordinator - hired with grant funding (Wilsonville campus)
- Assistant Professor (Klamath Falls Campus)
- Adjunct Professor (Klamath Falls Campus)
- Oregon Tech 3D Printing Lab Student Employee (Wilsonville campus)

PROMISING PRACTICES

Professor Interaction. Oregon Tech classes expose high school students to full-time faculty in a small class setting, allowing for them to connect with an expert in the field on an individual level. Grant funding covered the compensation costs for Oregon Tech faculty to teach college STEM courses to the *GHST* students. Classes are small, with a normal maximum class size of twenty-two students. Oregon Tech's Academic Partnerships Coordinator describes it as a "pretty personalized experience with the faculty member in the classroom." This gives students an extra contact in addition to *GHST* administration if they have questions about the field or college classes in general.

Hands-On Approach. According to Oregon Tech's Pre-College Coordinator, professors have found that HST students excel in classes with hands-on work, even outperforming traditional college students. Oregon Tech prides itself on offering "hands-on learning for real world achievement."[2] The Academic Partnerships Coordinator described a conversation with a *GHST* professor who said, 'I think I'm going to put all of my reading materials online so that when we get to class we will actually just build computers.' *GHST* program administrators believe those are the things that are most engaging to students. An adjunct professor who taught a Geographical Information Systems (GIS) class in Winter 2017 quickly introduced students to the software needed to create maps and described his approach as "sink or swim," allowing students to experience the software and then identifying and covering areas that they struggled in.

Tuition Reduction/Waiver. The Oregon Tech *HST* program already offered students reduced tuition of $25 per credit. Academic Partnerships Coordinator noted that even this reduced tuition cost can serve as a significant barrier to enrollment for low-income students. Grant funding covered compensation for faculty to teach the *GHST* classes, allowing Oregon Tech to offer college classes at no charge to high school students who qualified for free or reduced lunches. According to the Academic Partnerships Coordinator, "Having the grant take that dollar amount away was very helpful."

[1] The researchers were unable to interview student participants because they were minors.
[2] Oregon Tech (2017). Retrieved May 08, 2017 from http://www.oit.edu/

Pre-college Coordinator. Oregon Tech's Pre-College Coordinator was hired as a result of grant funding. This addition grew what program administration described as their "manpower" and "bandwidth between offices," allowing them to reach more students and also provide a more in-depth advising experience. The Pre-College Coordinator was able to travel to various college fairs and meet with school counselors to build partnerships, educating counselors on the opportunities for students to enroll in the program. He feels that the work that he did this year laid "the groundwork that should bear fruit in the coming year."

Travel Stipend. Grant funding allowed Oregon Tech to offer travel stipends for students located in rural or distant areas to travel to classes. The Academic Partnerships Coordinator shared a story of a student living near Portland, Oregon who used public transportation to travel two-and-half hours (roundtrip) to attend classes in Wilsonville; "they were able to do that with the grant funding."

Food Provision. The Wilsonville Oregon Tech campus currently has no food service or food vendors. There is a cafeteria for students to sit and eat, but no access to food on campus. As a result, it was vital to class success to provide the participating G*HST* students with meals during all-day classes. This allowed students to focus on the course materials instead of how to address their hunger.

STORIES OF IMPACT

The case study of Oregon Tech yielded a variety of stories, told by administrators and teaching faculty. These stories illustrate the impact of grant funding on the students enrolled in the *GHST* program.

Impressive Final Projects. An adjunct professor who taught Geographical Information Systems (GIS) in Winter 2017 described the experience of watching students go from no knowledge of basic concepts to creating their own maps using GIS software. He said, "It was cool to watch them go from not having any understanding on the subject to having a light bulb click." At the end of the term, the final projects produced by students, which combined student research with mapping techniques in GIS software, were described as "impressive."

Tremendous Opportunity. Early in the summer program, one student reached out to *GHST* program administration and expressed that "if this program didn't exist I would have never been able to have the opportunity to come on a college campus. This means a tremendous amount to me as a high school student to have this type of experience."

Altered Trajectory. The Academic Partnerships Coordinator described an interaction with a mother of a student; "We had a mom reach out to us, and she mentioned that her son was struggling in high school and was having a really hard time finding his place. He took the [*GHST* class] and was so reinvigorated academically that he entered an

early college program at one of our local community colleges. The impact was dramatic; the student was not engaged in his high school program and instead of continuing to withdraw, [the *GHST* program] pushed him into another trajectory."

Student Support. Despite personalized program efforts, not all students succeed in the intense hands-on courses offered by Oregon Tech's *GHST* program. The Pre-College Coordinator shared a student story that "shows kind of the bandwidth that Oregon Tech has [after grant funding] that can be spent on trying to get one student to succeed." This student was engaged in one of *GHST*'s summer courses, and was interested in attending Oregon Tech as a full-time student in the coming Fall. After noticing the student was struggling, the Pre-College Coordinator gave individual advising on a weekly basis to check progress on homework, provided a tutor through Oregon Tech's Peer Consulting Center, and set up interactions with professors. Though this student was ultimately unsuccessful in the courses he was enrolled in, this story shows the intensive personalized advising and support the *GHST* program is now able to offer struggling students as a result of grant funding.

Open Learners. A student employee at the Oregon Tech 3D Printing Lab worked with *GHST* students enrolled in Physical Science Applications in Space during Summer 2016. He worked closely with *GHST* students to design and 3D print platforms for their projects, which were launched into space. The student employee described the *GHST* students as "open learners." He went on to explain that college students are often unwilling to accept mentorship or assistance, but in his experience *GHST* students sought assistance and were willing to accept feedback and mentorship. An adjunct professor further described *GHST* students as "quick learners" and "easily taught."

CHALLENGES FACED

Grant Funding Timing. According to the Academic Partnerships Coordinator and the Pre-College Coordinator, the most difficult challenge that Oregon Tech faced was the timing of grant funding notification. Funding was granted mid-May, which gave the *GHST* program three and a half weeks to secure more than a hundred high school students enrolled before summer courses started. "It was intense in that we did not have enough time to orient or vet the students for the program. We essentially had to get their name and had them fill out a registration. We manually registered them, then started communicating through e-mail," says the Academic Partnerships Coordinator. The Academic Partnerships Coordinator noted this challenge affected the program throughout the whole summer; "It felt like we were playing catch-up."

Hiring Timing. Since grant funding only provided for a 9-month position, the Pre-College Coordinator was not hired until November, which was after summer programming occurred. The Pre-College Coordinator described this as "after the initial contact with Summer HST students." This caused difficulty reconnecting with students after the summer program since the Pre-College Coordinator was not there to build connections with students while they were enrolled in courses.

Limited Course Availability. Some courses proved to be more popular than other classes, meaning classes filled up quickly. When students tried to enroll in the full classes the Pre-College Coordinator and the Academic Partnerships Coordinator suggested they be enrolled them in the available classes so they would still get the college experience. As a result, students weren't fully engaged in the classes they enrolled in. The Academic Partnerships Coordinator indicated this "provided a disconnect."

Travel Stipends. The Academic Partnerships Coordinator and the Pre-College Coordinator had difficulty dispersing travel stipends to students who were traveling to attend classes. This difficulty was especially an issue since *HST* students are classified by Oregon Tech as non-admit students, complicating the release of funds by the business office due to internal policy, which further limited dispersing funds to non-admit students. They experienced what they described as difficulty navigating internal policy to provide the funding for students. "The business office was uncomfortable," says the Pre-College Coordinator. It took hours of work by the Pre-College Coordinator and the Academic Partnerships Coordinator's to transmit weekly stipends to those *GHST* students who were traveling to campus.

FUTURE DIRECTIONS

Vetting and Orientation. One of the biggest future changes to the *GHST* program is a more intensive vetting and orientation of students. This year, since the grant funding notification came so close to summer, the Academic Partnerships Coordinator and the Pre-College Coordinator scrambled to enroll students and had difficulty vetting and orienting students. In the future, *GHST* program administration will work more closely with high school counselors to identify students who are a good fit for college STEM courses, possibly increasing their minimum GPA requirement. Following student selection, orientation will more clearly explain to students how the college classroom is different from the high school classroom and will better prepare them for the expectations of college performance.

Increased Retention Efforts. In the future, the Academic Partnerships Coordinator and the Pre-College Coordinator would like to see the program perform more retention work. In the past, the program has focused on recruiting students into classes, but the focus moving forward will shift to a blend between both recruitment and retention.

Earlier Implementation. According to the Pre-College Coordinator, the program timeline will be significantly pushed back next year, with efforts starting months before they did for the 2016-17 year. The Pre-College Coordinator and the Academic Partnerships Coordinator are aware of how students make summer plans early, and want to reach students before they make other plans. Earlier implementation will allow the Pre-College Coordinator more time to collaborate with high school counselors and spread awareness of the option for students to take summer and after school classes.

Social Media Presence. The Pre-College Coordinator hopes to use social media to communicate with students in the future. Summer class photos and other materials will be used to share messages with students over Facebook, Instagram, Snapchat, and Twitter. *GHST* program administration believe this will be a more effective way to communicate with students, since they often do not check email.

CHEMEKETA COMMUNITY COLLEGE: *U-STEM*

Photo Courtesy of Genevieve Schaack

Chemeketa Community College's *U-STEM* program began in January of 2017 with the hiring of its Program Coordinator. Using the grant award of $152,236, the program seeks to assist underserved/underrepresented students in three STEM areas: engineering, high-tech manufacturing, and computer science. This program had a two faceted approach: (1) recruiting local high school students to Chemeketa and (2) supporting currently enrolled students pursuing STEM majors in their studies.

Recruitment efforts centered on three annual recruitment fairs. Twice a year, students from area high schools are invited to tour the campus and participate in workshops relating to robotics, drafting, and machinist work. Approximately 160 high school students have attended this year's events so far. A third event is planned for June 2017 in which all of the students that attended the first two fairs will be invited back with their families and there will be additional information provided about degree options, career possibilities and financial aid.

Ongoing support and retention efforts focused on 54 currently enrolled female and minority Chemeketa students pursuing STEM degrees into the *U-STEM* program. *U-STEM* employs four student workers who serve as tutors, mentors, and peer advisors. All Chemeketa students are required to meet regularly with advisors early in their college career, but the student-to-advisor ratio is around 270:1. Participation in the *U-STEM* program matches these students with peer advisors working with the Program Coordinator, lowering that ratio to closer to 10:1. Participants also have access to a lending library of upper division textbooks to help defray some of the costs of attendance. Each term, there are coordinated tours of 4-year institutions across the

state as well as visits from industry professionals and 4-year college recruiters to the Salem campus.

IMPACT OF GRANT FUNDING

- Hiring a full-time Program Coordinator
- Hiring 4 part-time student advisors/tutors
- Reaching 160 high school students and their families through 3 recruitment events
- Offering 54 current Chemeketa students specialized advising/tutoring services
- Providing course advising to current students at a significantly reduced student to advisor ratio of 10:1 versus 270:1 as it is for other students
- Creating a lending library of upper-level textbooks

CASE STUDY INTERVIEWS

- Program Coordinator
- 2 Student mentor/ advisors
- 2 Teaching faculty
- 3 Student participants
- Dean of Technical and Career Education

PROMISING PRACTICES

Recruitment Fairs and Following-Up. The *U-STEM* recruitment goal was to reach out to at least 100 area high school students and provide information on STEM majors. So far, the program has exceeded this goal this year by reaching approximately 160 students through the recruitment events described above. Following up with these students and inviting them and their families back for a third fair later in the school year may increase the effectiveness of the recruitment efforts as well as facilitate sustained program participation over time. There may be additional impact within the families of these students that return this spring to attend the third event. Included in their initial fair folder was information regarding Oregon Promise. Scholarship opportunities and additional advising and financial aid materials will be the focus of the content of the third event.

Student Choice. At recruitment fairs, students were given the choice of which of three fields they were most interested in, allowing them to spend more time learning about the degree and career options that most closely aligns with their current interests. The high school students then spent the morning in a hands-on workshop with both informational and practical components. Following lunch at the community college's food court (purchased with vouchers provided by *U-STEM*), the students toured the facilities and received a brief summary of the workshops for the two fields they did not choose to engage in.

Peer Advising and Mentorship. The *U-STEM* program hired four student employees that serve in a mentorship role, providing advising and tutoring. While Chemeketa has mandatory advising for its students, the students to advisors ratio is 270 to 1. *U-STEM* brings that number down to roughly 10 to 1. Student employees are able to develop personalized relationships with program participants to better meet their needs.

Student Employees that Majored in STEM. One of the student employees was a STEM major, and he was more successful in providing tutoring help with higher level coursework as well as having more familiarity with course offerings.

Multiple Modes of Contact. To facilitate enrollment, *U-STEM* worked with other departments to create a list of potential participants, contacted them initially via email and then followed up by text message. Two students interviewed stated that they forgot to follow-up on the initial *U-STEM* recruitment email, even though they had been interested. These students enrolled in the program after being called on the phone.

Lending Library. Textbooks are just one of the many financial barriers that underserved/underrepresented students face. *U-STEM* provides free access to textbooks that are not available at Chemeketa's libraries.

Cross-Campus Collaboration. *U-STEM* works diligently to make the most of administrative resources from other departments, such as compiling potential candidates, or organizing visits from industry professionals. This allows them to avoid overlap in resource provisions such as textbooks or tutoring in specific subjects and ensures the vitality and efficiency of the program.

External Collaboration. Multiple visits each term to 4-year institutions as well as on-site recruitment efforts help students continue on their path toward STEM careers, allowing them to investigate further academic options. Bringing industry professionals to the Chemeketa campus as well as bringing students to industry sites helps develop mentorship opportunities and refine student interests.

STORIES OF IMPACT

Confidence. All Chemeketa students interviewed stated they felt more confident in pursuing their degrees with the support of *U-STEM*. They cited the coordinator and the peer advisors' expertise as helping to ensure they felt "....more confident that I am doing the right thing at the right time and that I am not missing anything…". By developing relationships with the *U-STEM* workers, students felt more confidence to approach other faculty and staff.

Role Models. One student, the first in her immediate family to attend college, shared her desire to be a role model, to show that women, particularly women of color, belong in STEM majors and ultimately STEM careers. She had worked with one of the student advisor/tutors, in tutoring for several classes and felt reassured by sitting down with him to plan out her coursework over the next several years. Determining a course load that was manageable in addition to work was important to her to feel set up for success.

This student employee had taken several of the required courses, and so was able to offer firsthand advice in creating a balanced schedule for each term.

A Clear Path. Student participants echoed sentiments of gratitude for the *U-STEM* program's help with long term advising. Winnowing down the number of students per advisor while limiting their focus to a smaller number of majors allows for advising to be possible even for non-STEM major employees to become familiar with STEM degree requirements.

CHALLENGES FACED

Timeline of Implementation. Administratively, the biggest challenge was the timeline of implementation. The program coordinator was not hired until January, 2017, which was more than six months after the grant was awarded. Due this delay, the program was not fully staffed with student employees until considerably after the hire of the program coordinator.

Retaining Student Employees. One difficulty is that the classes for which peer tutors are needed to provide specialty tutoring in are typically taken toward the end of their time at Chemeketa. This means that they may not have the time to develop their tutoring skills before graduating. There may be a need to hire graduates as well as current students to meet the high level of tutoring demands.

Introductory Program Information. From the student perspective, *U-STEM* had bridged many of the advisory issues faced once enrolled, but one student expressed having difficulties finding out about course and degree offerings prior to enrollment and had trouble figuring out who could help provide the necessary information.

FUTURE DIRECTIONS

Increased Tutoring Support. One of the most critical student needs identified since the start of *U-STEM* is that of upper level tutoring outside the scope of other tutoring centers on campus. *U-STEM* is leading the charge in creating STEM-specific tutoring opportunities for students, located in the main STEM building on campus. This is seen as a vital service not offered elsewhere on campus.

Continued Recruitment. There is an emphasis on continuing exposure of program offerings to area high school students and their families to help increase recruitment. Reaching an ever-broadening audience of high school age students as well as tracking the successes of these efforts are a part of future plans.

Extended Retention. Several site visits are scheduled this term to help facilitate the students transferring from Chemeketa to 4-year colleges and universities. There are plans to continue to expand this program with several more industry partners in the future for those students earning terminal degrees in their field, providing more mentorship opportunities and hands-on experience.

OREGON HEALTH & SCIENCE UNIVERSITY: *ON TRACK OHSU!*

Photo courtesy of OHSU

Oregon Health and Science University (OHSU) was granted $266,750 for one year to supplement *On Track OHSU!*, an existing middle school and high school bridge program. Since its creation in 2013, the program has focused on increasing the number of underrepresented and underserved students in STEM degrees and careers. *On Track* is an initiative of the provost's office at OHSU and currently has five staff members and serves more than 2,250 middle school students and about 280 high school students per year. This year, about 80% of *On Track* students were from racial minority groups and 72% received free or reduced lunch.[3]

The program is divided into three communities: Woodburn, Jefferson High School Portland area, and the Confederated Tribes of Warm Springs. The provost's office wanted the program's communities to be chosen based on representation of African American/Black and Hispanic and Latino students. Also, for *On Track*'s first expansion, it was their directive to reach the Native American community. During the 2014-15 school year, *On Track* coordinated with the Confederated Tribes of Warm Spring's Education Committee and community members, and during the 2015-16 school year, *On Track* expanded to the Confederated Tribes of Warm Springs. STEM grant funding has allowed *On Track* to provide buses to the Confederated Tribes of Warm Springs to transport the students to OHSU and back to participate in programs.

For middle school students, *On Track*'s middle school director travels to teach two

[3] On Track OHSU! Mid Year Progress Report to the Higher Education Coordinating Commission, May 1, 2017.

science lessons a year onsite. These hands-on lessons are facilitated by high school volunteers, which allow the middle school students to see peers from their own communities who are experts in a science topic. This is also a powerful peer mentorship experience for the high school students. The middle school students also visit OHSU for a campus tour and a Stations Fair, which exposes them to a range of scientific degrees and career options. The Fair includes a simulated surgery station with nurses, sonography machines to look at their own veins, neuroscientists, dentists, pharmacists, biomedical engineers, and animal researchers. *On Track* provides transportation for middle school students in the Confederated Tribes of Warm Springs to attend the Stations Fair per request of the community.

For high school students, *On Track* provides four events throughout the school year. About 120 high school students from each community participate. *On Track* relies on the high schools for student selection, but they are usually have previously been middle school participants. High school students hear stories from college students and researchers from their communities, attend a more in-depth Stations Fair, complete an entire undergraduate chemistry lab assignment at PSU's chemistry lab with undergraduate volunteers, conduct guided college searches to explore their options, and visit OHSU's research labs, primate center, and simulation center. The program concludes with exit interviews and follow-up communication and support as students attend college or enter the career world. Many high school students also become volunteers for the middle school portion of *On Track*, which helps build a strong sense of ownership and community among the program participants, volunteers, and staff.

On Track has a part-time program evaluator who has been involved with *On Track* since its inception in 2013. The STEM grant allowed the program evaluator to increase her F.T.E. from 0.13 to 0.3, which has made a significant difference in her ability to support *On Track*.

IMPACT OF GRANT FUNDING

Upon asking the program director to articulate the impact of grant funding, she listed these impacts:

- Hired a full-time community liaison to support students during the transition between high school and postsecondary education, including academic and transfer advising.

- Increased the program evaluator's F.T.E. from 0.13 to 0.3 and funded part of the FTE for On Track director, program coordinator, and admin coordinator.

- Funded bus and substitute costs for all *On Track* visits.

- Funded food for all students during *On Track* visits.

- Provided middle school lesson supplies for interactive hands-on content.

- Funded travel and lodging for *On Track* staff when necessary.

- Created a more hands-on 10th grade visit partnered with PSU's Department of Chemistry.
    - These new program aspects allowed On Track to increase high school student participation by 45 percent this school year.

- Increased connectivity and inter-institutional partnerships with existing higher education partners and bridge and support programs such as Louis Stokes Alliance for Minority Participation (LSAMP), Federal TRiO programs (TRiO), and PSU's Building Infrastructure Leading to Diversity - Enhancing Cross-disciplinary Infrastructure Training at Oregon (BUILD EXITO).

- Increased access by providing resources for *On Track* students and volunteers to travel to clinical shadow and research sites.

- Worked with experts to ensure that programming throughout *On Track* is highly culturally responsive and informed by best practices.
    - *On Track* team enrolled in a training called "Reframing Racism" from the Center for Equity and Inclusion (2.5 day intensive, with three follow up sessions over the course of 3 months).
      o Partnered with the Let's Talk Diversity Coalition to offer a four part workshop series for any OHSU student or employee.

CASE STUDY INTERVIEWS

- Program Director of *On Track*
- Middle School Program Director of *On Track*
- Program Evaluator of *On Track*
- Community Liaison of *On Track*

On our behalf, the *On Track* program director dispersed a Qualtrics survey to the undergraduate volunteers of *On Track*. We received nine anonymous text-entry responses.

PROMISING PRACTICES

Near peer mentoring. Using high school students as volunteers and mentors for middle school programs creates a strong sense of ownership and community among program participants, volunteers, and staff. It is empowering for high school students, and it also helps younger students see role models that are from their communities. "In 2016-17, approximately 100 high school students volunteered to teach middle school students."[4]

[4] On Track OHSU! Mid Year Progress Report to the Higher Education Coordinating Commission, May 1, 2017.

Sustained program. "*On Track* provides a sustained set of contacts and opportunities for On Track students beginning in the 6th grade and extending through high school and beyond."[5] *On Track* interacts with students at least three times a year while they are in grades 6-8. For grades 9-10, they engage with at least one *On Track* program per year, and for grades 11-12, *On Track* provides four program-related visits to OHSU per year.

Administrators with teaching experience. People with teaching experience, especially science teachers, tend to have positive interactions with program administrators for middle and high school bridge programs. For example, *On Track*'s middle school director was previously a middle school science teacher. Because of that, "she brings an understanding of what it's like to be in the classroom."[6] This program involves working with teachers on a regular basis, so it is highly valuable to have program administrators who have "true empathy of what that role is like."[7] The program director was previously a chemistry teacher as well.

Community liaison. Employing a full time community liaison who is physically present at high schools every day creates a strong sense of identity for high school bridge programs as well as crucial day-to-day support for students as they face institutional and societal barriers to college. The community liaison works in the Woodburn high school and provides support and advising to high school students, mostly high school seniors who are transitioning to postsecondary education. She provides "more consistent, frequent, and culturally responsive contact" for *On Track* high school students.[8] As one volunteer indicated, the best way that *On Track* is supporting underrepresented students is by "Physically being in their school with OHSU on our badges."

Diversify funding sources. The STEM grant comprised about 50% of *On Track*'s budget for the 2016-17 school year. *On Track* is funded through a mixture of OHSU support, in kind donations (non-cash gifts or services), foundations, individual donors, state grants, and hopefully, in the future, federal grants. For grants, *On Track* currently receives grant funding from HECC, the Ford Family Foundation, and the Oregon Community Foundation. They are actively applying to several more grants to fund the 2017-18 school year. The Director said that when the HECC funding ends, it "is leaving a huge hole" in their budget.[9] Also, because this grant is for one year, it is difficult for administrators to demonstrate meaningful impacts through this grant. The Director plans to fill the budgetary gap left by the HECC grant. She said, "We can't bail on these initiatives. We've made promises to communities, and these are communities that

[5] On Track OHSU! Mid Year Progress Report to the Higher Education Coordinating Commission, May 1, 2017.
[6] Focus Group with Kathryn Lenahan, Emily Felsenstein, and Lindsey Smith, OHSU, April 21, 2017.
[7] Focus Group with Kathryn Lenahan, Emily Felenstein, and Lindsey Smith, OHSU, April 21, 2017.
[8] On Track OHSU! Mid Year Progress Report to the Higher Education Coordinating Commission, May 1, 2017.
[9] Personal Communication with Administrators at OHSU, Focus Group, April 21, 2017.

people have pulled back on their promises all the time. We will not be one of those organizations."

STORIES OF IMPACT

The community liaison told stories about three students she guided through the college application and preparation process. During the focus group, the program director, middle school program coordinator, and program evaluator each told two different stories relating to students growing their identities as potential scientists and having "aha" moments through hands-on activities that challenged their resilience toward finding the answers to scientific questions.

We used an online survey to gather stories from undergraduate volunteers of *On Track* who provided mentorship to high school students. Volunteers seemed very positive, inspired, and rewarded by being involved with participants.

Overcoming Failure. An undergraduate volunteer said, "I talked about applying to medical school more than once and how I kept trying even though I failed. I noticed that students really paid attention to that story."

Lasting Impressions. An undergraduate volunteer wrote, "I remember having a student come up to me at an unrelated event (Saturday Academy symposium) and say she recognized me from an *On Track* event and that what I had said during *On Track* meant a lot to her. It was incredibly rewarding to be recognized and thanked!"

Real Research Experiences. The director of *On Track* said that a student told her, these experiences are "not like our science classes. We're actually doing real research, and we didn't know the answer, and it's really cool to think that the things that we found will actually be used to help these scientists in the future."

Building Identities. A high school senior who participated in *On Track*'s clinical shadow experience said, "This really helped me. I always said that I wanted to be a doctor, but this gave me the confidence that, for sure, I love this. This where I see myself, and I want to go on to pediatrics." This exemplifies how this program helps build students' identities as STEM professionals.

CHALLENGES FACED

One Year of Funding. Because the STEM grant was administered for one year, for the 2017-18 school year, *On Track* must meet its budgetary requirements without this grant funding. The STEM grant comprised 50% of the total *On Track* budget. *On Track* expanded a significant portion of their programming and hired a full-time community liaison with money that is going to end on June 30, 2017. This has left the program director with a 50% budgetary gap that she is currently seeking grant funding to cover for the next school year and beyond.

Over-asking Volunteers. Another challenge that *On Track* faces is asking volunteers from diverse backgrounds to volunteer and represent their communities many times throughout the program. According to their mid-progress report:

> "The demands on volunteers of color are already enormous. These individuals are asked repeatedly to represent their communities and to do outreach. We must be sensitive to this as we recruit volunteers and remain highly respectful of their time."[10]

To mitigate this, *On Track* is recruiting volunteers from Portland State University and other nearby colleges to expand their pool of available volunteers from underrepresented communities in STEM.

FUTURE DIRECTIONS

Community Liaison Model. *On Track* realizes that there is a "critical need for a strong community presence throughout [their] programming."[11] *On Track* wants to hire more community liaisons and move toward a community liaison model. The current community liaison is serving as a pilot for this type of role and, over the past year, has encouraged *On Track t*o pursue placing community liaisons in their other two communities: the Jefferson High School cluster and the Confederated Tribes of Warm Springs. *On Track* wants to hire two more community liaisons within the coming year.

Ideally the community liaisons will be from the respective communities so that they bring the experiences and cultural responsiveness necessary to effectively work within those communities. The current Woodburn liaison is originally from Woodburn, has a degree in Public Health from OSU, and provides culturally responsive expertise to the services that she provides for students in that community. The community liaisons' responsibilities include:

- Supporting students during the transition between high school and postsecondary education, including academic and transfer advising
- Working with family and community members so they can support their students in their future successes
- Increasing cultural awareness and sensitivity of all On Track volunteers and staff

[10] On Track OHSU! Mid Year Progress Report to the Higher Education Coordinating Commission, May 1, 2017.
[11] On Track OHSU! Mid Year Progress Report to the Higher Education Coordinating Commission, May 1, 2017.

CONCLUSION

Our research identifies promising practices and challenges that individual sites faced and also aspects that were shared across the three sites. Promising practices centered around guiding students through bureaucratic systems such as college applications and registering for classes because students often feel overwhelmed by these processes and need help advocating for themselves on an institutional level. Other best practices involve peer mentorship with older students from diverse communities that serve as models for incoming students in STEM programs. Peer mentorship is enhanced when programs also allow students to take college courses ahead of time, sometimes with a mentor, as a preview of the STEM degree programs to come. Interacting with STEM professors and professionals at science fairs is also a powerful way to help students envision themselves as future STEM professionals. Students stated that this experience would be even more impactful if the professionals with whom they meet are also from diverse communities. From an administrative perspective, we learned that it is most effective for programs to reach out to students via phone calls as well as through traditional emails.

Most of the challenges that we identified related to the grant timeline, which did not allow enough time for implementation of new programs at the sites. Sites that started new programs had trouble hiring coordinators and student tutors and mentors within enough time. A specific challenge for OHSU's program involves lack of volunteers from diverse communities to serve as mentors. At Chemeketa, students expressed challenges with accessing information about available program offerings. Since all three sites use high school bridge programming, another challenge they face is trouble tracking students once they graduate from high school. Overall, the most significant and universal challenge is that STEM grant funding is expiring on June 30, and there is no guarantee of future funding.

STUDY LIMITATIONS

This research serves to understand the programs of three of the grant recipient sites. While efforts were made to capture a cross-section of programs and institutions and to speak with as many participants as possible, these findings are not meant to be generalized. Some considerations in this are bias, the sample size of participants, and the nascent nature of the grant and some of these programs.

Bias. Selection bias is the primary consideration. The qualitative nature of this investigation requires that respondents have opted-in to the research study on some level.

Participants. Enrollment in several of these programs was ongoing at the time of investigation, limiting the overall size of the pool of possible participants. Age was another consideration as many of the programs work with students under the age of 18, and there was not enough time to provide for safety considerations with regard to their study participation.

Lack of Longitudinal Information. Since this was a one-year grant, the research findings are preliminary. Many of the programs funded are pilot programs at this time. While OHSU used grant funds to expand an already successful program, the true impact of Oregon Tech and Chemeketa's programs cannot be fully realized without continued support. In order to assess long term impacts, the grant funding would need to be continued.

APPENDIX A- SITE SELECTION

The following table describes the breadth of programming across sites.

Institution	**Curricular Emphasis/ Outcome**	**Curricular Emphasis**	**Program Efforts**	**Projected Student Impact** [12]	**Cost per Student**[3]	**Total Award**[3]
Chemeketa Community College	Associate's Degree	Computer Science, Engineering, High-Tech Manufacturing	*U-STEM*: Bridge/ Recruitment Workshops, Career Training, Tutoring and Mentorship	50 directly enrolled, 150 total	$1,063	$152,236
Oregon Institute of Technology	Bachelor's Degree	Biology, Clinical Pathology, Computer Science, Engineering, Geographic Information Systems, Management Information Systems	Guided STEM HST College Courses, Pre-college advising, Transportation Stipends, Peer Texting Program, and Academic Transition Events	315	$587	$184,960,
Oregon Health and Science University	Medical and Medical Professional Degree	Intensive lab experiences with mentors	Bridge to College, Mentorship	275	$950	$266,750

[12] HECC STEM Equity Grant Estimated Student Impact

APPENDIX B- LITERATURE REVIEW

INTRODUCTION

Our research collects stories from higher education institutions that were awarded the Oregon HB 3072 STEM grant in an effort to address the lack of racial, ethnic, and gender diversity among students pursuing higher education degrees in science, technology, engineering and math (STEM) fields. Stories from three higher education institutions in Oregon were collected for this study: Chemeketa Community College (CCC), Oregon Health and Science University (OHSU), and Oregon Institute of Technology (Oregon Tech or OIT). These institutions were selected from the nine institutional recipients of postsecondary HB 3072 STEM grant. Oregon Tech, OHSU, and CCC were selected for this study because they represent a broad spectrum of programs and practices employed by the nine grant recipients.

In the context of the HB 3072 STEM Grant's efforts to address the lack of diversity among STEM degree recipients, underserved and underrepresented students are the target population. The terms "underserved" and "underrepresented" are often used interchangeably in current literature, generally referring to students whose representation in STEM fields is considerably smaller than their representation in the U.S. population. Underserved and underrepresented students in STEM disciplines are primarily Native American/Alaskan Natives, African Americans, Latinos, and women.

PROBLEM BACKGROUND

To address the lack of gender and racial diversity in STEM fields, Oregon's Higher Education Coordinating Commission (HECC) dispersed competitive grant funding for the HB 3072 STEM Grant in 2016. The HB 3072 STEM Grant was awarded to nine higher education institutions across the state of Oregon with the goal of increasing underserved/underrepresented student enrollment and degree/certificate completion in STEM programs. Grant funding was used to expand existing projects or to start new programs. The societal problem of diversity in STEM fields, which the HB 3072 STEM Grant was designed to address, is visible in academic, workplace, and economic contexts and is further discussed in this section.

Academic Context. Lack of diversity among students pursuing STEM degrees can be attributed to four main factors: (1) the K-12 learning system, which does not promote or support underserved/underrepresented students to pursue higher education in STEM fields; (2) higher education tuition costs serve as a barrier for many underserved/underrepresented students; (3) racial/ethnic minorities and women face obstacles throughout their studies that make it difficult for them to complete STEM degrees; (4) underserved/underrepresented students with STEM baccalaureate degrees often do not have competitive applications for graduate school admission.[13] These factors contribute to a widespread lack of underserved/underrepresented

[13] Clewell et al., "Revitalizing the Nation's Talent Pool in STEM."

students in the U.S. STEM workforce.[14]

K-12 Learning System. Exposure to STEM topics during K-12 years is a key factor in determining whether students will continue to pursue a higher education STEM degrees. Inadequacies in K-12 education leave students without confidence or certainty in their abilities to learn and perform STEM tasks,[15] leading to an increasingly wide achievement gap for underrepresented/underserved students. One study found that "African American and Hispanic students might not have access to high school subjects and courses that are important to later success in STEM degree programs in college."[16] As a result, "sixty-one percent of African American students reported that they lacked interest in STEM careers."[17] Similarly, a recent study found that female students also lack interest in STEM fields due to beliefs that they do not possess the necessary skills or knowledge for those fields.[18] The study found that such perceptions were not present when girls were encouraged to participate in STEM subjects in school.[19] This emphasizes the need to reach underrepresented students while they are in the K-12 education system by exposing them to STEM fields through engaging and supportive programs.

Tuition Barriers. Tuition often serves as a barrier to attainment of STEM degrees for minority students. Racial/ethnic minorities are considerably less likely to receive tuition contributions from parents or other relatives, pushing degree completion out of reach for many minority students.[20] This tuition barrier leads underrepresented students who want to pursue STEM degrees to enroll in community colleges and other two-year colleges. Two-year colleges are a good start for attainment of STEM degrees, but they are often the highest level of education attained by many underrepresented students.[21] "While community colleges enroll close to half of all students from groups traditionally underrepresented in STEM disciplines, only twenty-six percent of students at two year colleges transfer to four year institutions."[22]

In higher education, STEM degree programs are, with little exception, the least diverse.[23] For example, according to the National Science Foundation's 2017 "Women, Minorities, and Persons with Disabilities in Science and Engineering Report," of all

---

[14] Beatriz Chu Clewell, Clemencia Cosentino de Cohen, Lisa Tsui, and Nicole Deterding, "Revitalizing the Nation's Talent Pool in STEM," *The Urban Institute Research Report*, (2006).
[15] Clewell et al., "Revitalizing the Nation's Talent Pool in STEM."
[16] W. Lee Tyson, R. K. M. Borman, M. A. Hanson, "Science, technology, engineering, and mathematics (STEM) pathways: High school science and math coursework and postsecondary degree attainment." *Journal of Education for Students Placed at Risk* 12 (2007): 243-270.
[17] University of the Sciences, "Minorities represent largest sector not interested in pursuing STEM careers" Press Release (2012).
[18] Leslie et al. Expectations of brilliance underlie gender distributions across academic disciplines (2015).
[19] Leslie et al. Expectations of brilliance underlie gender distributions across academic disciplines.
[20] K. Saunders, "Barriers to success: unmet financial need for low income students of color in community colleges," Center for Postsecondary and Economic Success (2015).
[21] Clewell et al., "Revitalizing the Nation's Talent Pool in STEM."
[22] Clewell et al., "Revitalizing the Nation's Talent Pool in STEM."
[23] Daryl, E.Chubin, "Making a Case for Diversity in STEM Fields," Inside Higher Ed (October 2008).

enrolled undergraduates in the U.S. who earned bachelor's degrees in engineering in 2012, eighteen percent were women, eight percent were Hispanic, and four percent were Black.[24] These issues persist despite the fact that more women than men are enrolling in higher education in general.[25] Additionally, colleges struggle to retain students of *any* background in STEM degrees, with STEM graduation rates substantially lower than that of other degrees, according to the Higher Education Research Institute at UCLA.[26]

Female Student Obstacles to STEM. While both minority and female student groups face obstacles in pursuing STEM education, these obstacles may manifest themselves in different ways. For women in STEM, these obstacles often take the form of systemic messages that STEM disciplines are not feminine and are inconsistent with societal gender expectations.[27] "These beliefs tie to stereotypical expectations that women lack STEM abilities or should prioritize family over career roles."[28] "As early as Grades 5 and 6, girls report less confidence in their math and science abilities than boys do."[29] According to data from the National Girls Collaborative Project, in high school AP computer science classes, eighty-one percent of students are male while nineteen percent are female.[30] "In 2012, women earned 63% of all associate's degrees [but only] 29% of associate's degrees in STEM."[31] Although women earned fifty-seven percent of all bachelor's degrees in the U.S. in 2013, they only earned nineteen percent of engineering degrees and eighteen percent of computer science degrees.[32] "Women are more likely than men to switch out of STEM majors--32 percent vs. 26 percent."[33] In graduate school, the STEM achievement gap widens even more for women of color.[34] Minority women earned only "8.2% of master's degrees in science and engineering, and 4.1% of doctorate degrees in science and engineering" in 2012.[35]

Minority Student Obstacles to STEM. For racial/ethnic minorities, these obstacles often take the form of racism and discouragement on both institutional and individual levels. In elementary school, children of color experience substantial science

---

[24] National Science Foundation website, "Women, Minorities, and Persons with Disabilities in Science and Engineering," (January 2017): 8.
[25] National Science Foundation website, "Women, Minorities, and Persons with Disabilities in Science and Engineering," 8.
[26] Newkirk, "Boosting Science with Diversity."
[27] N.W. Brickhouse, P. Lowery, and K. Schultz, "What kind of a girl does science? The construction of school science identities." *Journal of Research in Science Teaching* 37 (2000): 441.
[28] C. Leaper and C. S. Brown, "Perceived experiences with sexism among adolescent girls." *Child Development* 79 (2008): 685-704.
[29] Frank Pajares, "Gender differences in mathematics self-efficacy beliefs," in A. M. Gallagher &J. C. Kaufman (Eds.), *Gender differences in mathematics: An integrative psychologicalapproach*, 294–315.
[30] National Girls Collaborative Project Statistics webpage.
[31] Change the Equation webpage on STEMtistics, STEM degrees.
[32] National Girls Collaborative Project Statistics webpage.
[33] Change the Equation webpage on STEMtistics, Higher Education.
[34] National Girls Collaborative Project Statistics webpage.
[35] National Science Foundation website, "Women, Minorities, and Persons with Disabilities in Science and Engineering."

achievement gaps that continue to widen through high school.[36] For example, by the end of middle school, twelve percent of African American students have taken Algebra I compared to forty-eight percent of Asian students.[37] In 2015, among high school students who took the Advanced Placement (AP) computer science test in high school, seventy-eight percent were male and just thirteen percent identified as either Black or Latino.[38] The same 2016 study shows that in nine states, not one black student took the AP test.[39] This exemplifies one way in which the science achievement gap manifests itself in high school as a significant underrepresentation of racial/ethnic minority groups in pre-college education. If and when students who belong to minority ethnic/racial groups enter college, they are often left to bridge the considerable gaps created and fostered in the K-12 education system on their own.[40]

A survey of 1,226 women and minorities who were members of the American Chemical Society (a society for chemists and chemical engineers) found that forty percent of them were discouraged by individuals while they were pursuing STEM degrees.[41] Half of Latinas and Black men reported discouragement in academia – the highest levels of any group surveyed.[42] College professors were the individuals reported to be the primary source of discouragement for minorities pursuing STEM degrees. [43]Racially targeted discouragement can prevent underrepresented students from pursuing STEM degrees; Eccles, Wong, and Peck found that discrimination predicts poorer academic motivation and academic success.[44] But these messages may not stop once minorities have left academia - one study found that almost half of all Black women and Latinas in STEM fields reported being mistaken for custodial staff while performing STEM duties in their offices.[45]

Applications for Graduate School. As a result of the various obstacles they face in the academic pipeline, racial/ethnic minority and female students are far less likely to pursue postsecondary degrees in STEM fields. Clewell et al. found that minority students who successfully obtain higher education STEM degrees often lack the laboratory research skills and other necessary requirements to compete for graduate school admission.[46] This means that the transition between undergraduate and graduate school is yet another place where underrepresented/underserved students are

[36] Vann R. Newkirk II, “Boosting Science with Diversity,” *Nova Next* (March 2016).
[37] National Science and Math Initiative webpage, “Transform Education” (2017).
[38] Mikhail Zinshteyn, “The Reality of Coding Classes,” *The Atlantic* (Feb. 2016).
[39] Zinshteyn, “The Reality of Coding Classes.”
[40] Newkirk, “Boosting Science with Diversity.”
[41] Bayer Corporation, “Bayer Facts of Science Education XIV: Female and Minority Chemists and Chemical Engineers Speak about Diversity and Underrepresentation in STEM,” (2010).
[42] Bayer Corporation, “Bayer Facts of Science Education XIV: Female and Minority Chemists and Chemical Engineers Speak about Diversity and Underrepresentation in STEM.”
[43] Bayer Corporation, “Bayer Facts of Science Education XIV: Female and Minority Chemists and Chemical Engineers Speak about Diversity and Underrepresentation in STEM.”
[44] J. S. Eccles, C. A. Wong, and S. C. Peck, “Ethnicity as a social context for the development of African American adolescents.” *Journal of School Psychology* 44 (2006): 407-426.
[45] Williams, Phillips & Hall (2010). Double Jeopardy? Gender Bias Against Women In Science.
[46] Clewell et al., “Revitalizing the Nation's Talent Pool in STEM.”

lacking throughout the STEM education pipeline. Myers and Pavel found that programs that intervene during underrepresented students' undergraduate educations through addressing these obstacles and providing support services and needed opportunities greatly increase the chances of these students' pursuit of graduate degrees in STEM fields.[47]

Need for Different Approaches. Underrepresentation of Native Americans, African Americans, Latinos, and women among students who complete STEM bachelor's degrees and enter STEM fields of employment has emerged as an area of emphasis and improvement,[48] though it is interesting to note that it is not a problem unique to the United States and is an issue faced by many other countries, such as Australia, Canada, and the United Kingdom.[49] For decades in the U.S., there has been growing emphasis on diversity and inclusion. However, studies suggest that these efforts are have little effect on diversity in STEM disciplines. Data from *Change the Equation* shows that, from 2001-2015, there is no increase in diversity among workplaces in STEM fields.[50] "Non-Asian minorities... are statistically less likely to be exposed to STEM professionals, have access to STEM education and hold STEM jobs."[51] This calls for more innovative and inclusive approaches to solving this deeply rooted diversity problem within the highly paid and highly respected disciplines of STEM.

Workplace Context. The lack of diversity within the STEM sector's highly paid and respected jobs can be analyzed from a greater economic and sector-wide perspective. Growth in STEM jobs is more robust than any other U.S. sector.[52] Since 2007, "computer and math jobs have grown by 725,000 or 21 percent, which is faster than any other occupational category."[53] By 2018, Occupational Employment Statistics (OES) estimates that there will be more than 650,000 new STEM jobs that will need to be filled.[54] STEM positions are also attractive because, on average, they pay twenty-six percent higher salaries than non-STEM jobs do.[55] On average, of all undergraduate degrees, bachelor's degrees in engineering lead to jobs with the highest median salaries ($92,000).[56]

"Half of all STEM jobs don't require a four-year degree and pay an average of $53,000,

---

[47] Myers and Pavel, 2011
[48] P. Gándara and J. Maxwell-Jolly, "Priming the Pump: Strategies for increasing the achievement of underrepresented minority undergraduates." (1999); U. Treisman, "Studying students studying calculus: A look at the lives of minority mathematics students in college," The College Mathematics Journal 23 (1992): 362–372.
[49] Alison Phipps, "Re-inscribing gender binaries: Deconstructing the dominant discourse around women's equality in science, engineering, and technology." *The Sociological Review* 55, (2007): 768–787.
[50] Allie Bidwell, "STEM Workforce No More Diverse Than 14 Years Ago," *US News and World Report* (2015).
[51] Cindy Huang, "How One STEM School Aims to Lower the Achievement Gap," PBS Newshour (2013).
[52] Bureau of Labor Statistics website, Occupational Employment Statistics (2016).
[53] Brookings Institution, "Still Searching: Job Vacancies and STEM Skills," (2014).
[54] Bureau of Labor Statistics website, Occupational Employment Statistics.
[55] Cindy Huang, "How One STEM School Aims to Lower the Achievement Gap," *PBS Newshour.*
[56] Change the Equation webpage on STEMtistics, STEM degrees (2017).

which is 10 percent higher than non-STEM jobs with similar education requirements."[57] By 2018, of all available jobs in the STEM sector, ninety-two percent will require some level of higher education, whether that be Associate's degrees or beyond.[58] By 2022, ninety percent of all new engineering jobs will require a minimum of a bachelor's degree.[59]

Despite the fact that half of U.S. children are girls and an increasing number identify as underrepresented minorities, interest in this field is concentrated among white and Asian men.[60] According to a 2017 National Science Foundation report, eighty-four percent of working professionals in U.S. STEM jobs are white or Asian males.[61] Globally, women comprise only about twenty-eight percent of scientific researchers.[62] In the U.S., eleven percent of physicists and astronomers are women, ten percent of electrical or computer hardware engineers are women, and only eight percent of mechanical engineers are women.[63] The intersectionality of gender and race widens this gap in the STEM workforce even more. "Minority women comprise fewer than 1 in 10 employed scientists and engineers."[64] This lack of diversity is not as pronounced in some other developed nations. For example, in China, forty percent of engineers are women.[65]

Greater Economic and STEM Sector Context. As our national focus on diversity and inclusion has progressed, so has our research and data collection on how diversity affects the outcomes of STEM fields. Research into this area is still emerging, but data is beginning to indicate that the inclusion of a diverse range of people in STEM fields results in more innovation and success not only for the sector but also for the national economy at large.

In a recent study by the University of Michigan, researchers found that diversity "improves scientific productivity, discovery, and fairness of results."[66] Furthermore, the study suggests that diverse teams of scientists may have a competitive edge over more homogenous groups of scientists.[67] According to a University of Maryland and Columbia Business School joint study, a more diverse STEM population leads to more

[57] Change the Equation webpage on STEMtistics, STEM degrees.
[58] National Science and Math Initiative webpage, "Transform Education" (2017).
[59] Change the Equation webpage on STEMtistics, STEM degrees.
[60] Bureau of Labor Statistics website, Occupational Employment Statistics.
[61] National Science Foundation website, "Women, Minorities, and Persons with Disabilities in Science and Engineering."
[62] The United Nations Educational, Scientific and Cultural Organization (UNESCO) Asia-Pacific Education Thematic Brief, "Gender gap in STEM: Drawing more girls and women into Science, Technology, Engineering and Mathematics" (2016): 1.
[63] National Science Foundation website, "Women, Minorities, and Persons with Disabilities in Science and Engineering."
[64] National Science Foundation website, "Women, Minorities, and Persons with Disabilities in Science and Engineering."
[65] Bureau of Labor Statistics website, Occupational Employment Statistics.
[66] Newkirk, "Boosting Science with Diversity."
[67] Newkirk, "Boosting Science with Diversity."

technological innovations at large.[68] According to a 2016 *Harvard Business Review* article, data suggests that diverse teams are simply smarter than their homogeneous counterparts.[69] Evidence suggests that a firm's potential for innovation, critical thinking, and problem solving is enriched when representatives of different genders, races, and nationalities are part of their teams.[70]

According to Kenneth Gibbs Jr., a nationally renowned expert on science and diversity, in terms of the U.S. national economy, enhancing diversity is key to long term economic growth and global competitiveness.[71] In Gibbs' 2014 *Scientific American* article, he states that a nation's long term economic growth is tied to its scientific advancements, and scientific advancements rely entirely on the STEM workforce.[72] Thus, according to Gibbs,

> "The continued underrepresentation of minorities and women in the scientific enterprise represents a challenge to the United States' ability to, in the long-term, cultivate an adequate, domestic scientific workforce. It is hard to grow a workforce–let alone get the 'best' workforce–when there's broad underrepresentation of up to 75 percent of the potential talent pool."[73]

[68] Christian L. Dezső and David Gaddis Ross, "'Girl Power:' Female Participation in Top Management and Firm Performance," University of Maryland and Columbia Business School joint study (2007).
[69] David Rock and Heidi Grant, "Why Diverse Teams Are Smarter," Harvard Business Review (2016).
[70] Rock and Grant, "Why Diverse Teams Are Smarter."
[71] Kenneth Gibbs, Jr.,"Diversity in STEM: What It Is and Why It Matters," *Scientific American Voices* (2014).
[72] Gibbs,"Diversity in STEM: What It Is and Why It Matters."
[73] Gibbs,"Diversity in STEM: What It Is and Why It Matters."

APPENDIX C- WORKS CITED

Bayer Corporation (2010). Bayer Facts of Science Education XIV: Female and Minority Chemists and Chemical Engineers Speak about Diversity and Underrepresentation in STEM. Retrieved from: http://hub.mspnet.org/index.cfm/20590

Bidwell, Allie, (February 2015). "STEM Workforce No More Diverse Than 14 Years Ago," *US News and World Report*, Accessed from: https://www.usnews.com/news/stem-solutions/articles/2015/02/24/stem workforce-no-more-diverse-than-14-years-ago

Brickhouse, N. W., Lowery, P., & Schultz, K. (2000). "What kind of a girl does science? The construction of school science identities." *Journal of Research in Science Teaching*, 37, 441.

Bureau of Labor Statistics website, Occupational Employment Statistics (OES) (May 2016). Accessed from: https://www.bls.gov/oes/

Byars-Winston, Angela, (December 14, 2014). "Toward a Framework for Multicultural STEM-Focused Career Interventions," *Career Development Quarterly*. 62(4): 340-357. doi: 10.1002/j.2161-0045.2014.00087.x

Center for Workforce Development, (May 2015). "Pacific Northwest Louis Stokes Alliance For Minority Participation Year 1 Internal Evaluation Report" University of Washington.

Change the Equation webpage on STEMtistics, STEM degrees (2017). Accessed from: http://www.changetheequation.org/stemtistics

Chubin, Daryl, E., (October 2008). "Making a Case for Diversity in STEM Fields," *Inside Higher Ed*, Accessed from: https://www.insidehighered.com/views/2008/10/06/making-case-diversity-stem fields

Clewell, Beatriz Chu, Clemencia Cosentino de Cohen, Lisa Tsui, and Nicole Deterding (2006). "Revitalizing the Nation's Talent Pool in STEM," *The Urban Institute Research Report*, April 6, 2006. Accessed from: http://www.urban.org/research/publication/revitalizing-nations-talent-pool stem/view/full_report

Dezső, Christian, L. and David Gaddis Ross (2007). "'Girl Power:' Female Participation

in Top Management and Firm Performance," University of Maryland and Columbia Business School joint study, Accessed from https://www0.gsb.columbia.edu/mygsb/faculty/research/pubfiles/3063/girlpower.df

Eccles, J. S., Wong, C. A., & Peck, S. C. (2006). "Ethnicity as a social context for the development of African American adolescents." *Journal of School Psychology*, 44, 407-426.

Huang, Cindy, (January 8, 2013). "How One STEM School Aims to Lower the Achievement Gap," *PBS Newshour,* Accessed from: http://www.pbs.org/newshour/rundown/how-one-stem-school-aims-to-lower-the achievement-gap/

HECC Request for Grant Applications (RFA) #16-034 (ORPIN #525-1005-15).

Gándara, P., and Maxwell-Jolly, J. (1999). "Priming the Pump: Strategies for increasing the achievement of underrepresented minority undergraduates." New York : The College Board.

Gibbs, Jr., Kenneth (September 10, 2014). "Diversity in STEM: What It Is and Why It Matters," *Scientific American* Voices, Accessed from: https://blogs.scientificamerican.com/voices/diversity-in-stem-what-it-is-and-why it-matters/

Leaper, C., & Brown, C. S. (2008). "Perceived experiences with sexism among adolescent girls." *Child Development*, 79, 685-704. doi:10.1111/j.1467 8624.2008.01151.x

Leslie, S.J. et al. (2015) Expectations of brilliance underlie gender distributions across academic disciplines. Science 347, (5). DOI: 10.1126/science.1261375

Myers, C.B & Pavel, D. (2011). Underrepresented students in STEM: The transition from undergraduate to graduate programs. Journal of Diversity in Higher Education, Vol 4(2), Jun 2011, 90-105.

National Girls Collaborative Project Statistics webpage (2017). Accessed from: https://ngcproject.org/statistics

National Science and Math Initiative webpage, "Transform Education" (2017). Accessed

rom: https://www.nms.org/Education.aspx

National Science Foundation, (January 2017). “Women, Minorities, and Persons with Disabilities in Science and Engineering,” Accessed from: https://www.nsf.gov/statistics/2017/nsf17310/

Newkirk II, Vann R. (March 2016). “Boosting Science with Diversity,” *Nova Next*. Accessed from: http://www.pbs.org/wgbh/nova/next/body/stem-diversity/

Oregon Tech (2017). Retrieved May 08, 2017 from http://www.oit.edu/

On Track OHSU! Mid Year Progress Report to the Higher Education Coordinating Commission, May 1, 2017.

Pajares, F. (2005). Gender differences in mathematics self-efficacy beliefs. In A. M. Gallagher & J. C. Kaufman (Eds.), Gender differences in mathematics: An integrative psychological approach (pp. 294–315). New York: Cambridge University Press.

Phipps, A. (2007). “Re-inscribing gender binaries: Deconstructing the dominan discourse around women's equality in science, engineering, and technology.” *The Sociological Review*, 55(4), 768–787. doi:10.1111/j.1467 954X.2007.00744.x.

Rock, David and Heidi Grant (November 2016). “Why Diverse Teams Are Smarter,” *Harvard Business Review*, Accessed from: https://hbr.org/2016/11/why-diverse teams-are-smarter

Rothwell, Jonathan, (July 2014). “Still Searching: Job Vacancies and STEM Skills,” Brookings Institution, Accessed from https://www.brookings.edu/wp content/uploads/2014/07/Job-Vacancies-and-STEM-Skills.pdf.

Saunders, K. (2015). Barriers to success: unmet financial need for low income students of color in community colleges. Center for postsecondary and economic success. Retrieved from: https://csd.wustl.edu/Publications/Documents/RB16-14.pdf

Treisman, U. (1992). “Studying students studying calculus: A look at the lives of minority mathematics students in college,” *The College Mathematics Journal*, 23, 362 372.
doi:10.2307/2686410.

Tyson, W., Lee, R., Borman, K. M., & Hanson, M. A. (2007). “Science, technology, engineering, and mathematics (STEM) pathways: High school science and math coursework and postsecondary degree attainment.” *Journal of Education for Students Placed at Risk* (JESPAR), 12, 243-270.

The United Nations Educational, Scientific and Cultural Organization (UNESCO) Asia Pacific Education Thematic Brief, “Gender gap in STEM: Drawing more girls and women into Science, Technology, Engineering and Mathematics” (2016).

University of the Sciences. (2012). “Minorities represent largest sector not interested in pursuing STEM careers” [Press Release]. Retrieved from http://www.usciences.edu/newsEvents/newsDetails.aspx?Channel=%2FChannes%2FAdmissions%- 2FAdmissions+Content&WorkflowItemID=61a1f646-130e 4372-afe0- a60e61b9a359

University of Washington website, PNW LSAMP page, Accessed from: http://depts.washington.edu/lsamp/

Williams, Phillips & Hall (2010). Double Jeopardy? Gender Bias Against Women In Science. Retrieved from: http://www.toolsforchangeinstem.org/double-jeopardy report-viewer/

Zinshteyn, Mikhail, “The Reality of Coding Classes,” *The Atlantic*, February 1, 2016. Access From: https://www.theatlantic.com/education/archive/2016/02/obamas push-for-computer-science-education/459276/