# Akamai Workforce Initiative: A New Era of Building a Multi-Level Diverse Workforce in Astronomy and Remote Sensing

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07/16/2020
Final Report

# REPORT DOCUMENTATION PAGE

*Form Approved*
*OMB No. 0704-0188*

| 1. REPORT DATE *(DD-MM-YYYY)* 22-07-2020 | 2. REPORT TYPE Final Performance | 3. DATES COVERED *(From - To)* 30 Sep 2015 to 29 Sep 2018 |
|---|---|---|

**4. TITLE AND SUBTITLE**
Akamai Workforce Initiative: A New Era of Building a Multi-Level Diverse Workforce in Astronomy and Remote Sensing

**5a. CONTRACT NUMBER**

**5b. GRANT NUMBER**
FA9550-15-1-0427

**5c. PROGRAM ELEMENT NUMBER**
61102F

**6. AUTHOR(S)**
Lisa Hunter

**5d. PROJECT NUMBER**

**5e. TASK NUMBER**

**5f. WORK UNIT NUMBER**

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**
UNIVERSITY OF CALIFORNIA SANTA CRUZ
1156 HIGH ST
SANTA CRUZ, CA 950641077 US

**8. PERFORMING ORGANIZATION REPORT NUMBER**

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
AF Office of Scientific Research
875 N. Randolph St. Room 3112
Arlington, VA 22203

**10. SPONSOR/MONITOR'S ACRONYM(S)**
AFRL/AFOSR RTB1

**11. SPONSOR/MONITOR'S REPORT NUMBER(S)**
AFRL-AFOSR-VA-TR-2020-0104

**12. DISTRIBUTION/AVAILABILITY STATEMENT**
A DISTRIBUTION UNLIMITED: PB Public Release

**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**
This project addresses workforce challenges in Hawai'i and nationally, through the Akamai Workforce Initiative. Hawai'i is a vital resource for advancing U.S. research, technology and national security, in the fields of astronomy and space situational awareness, but faces ongoing challenges in meeting workforce needs and maintaining productive community relations. In Hawai'i, workforce development shortfalls have the potential to impede U.S. leadership in astronomy & space surveillance, and the situation exemplifies problems faced by many large, remotely located facilities. Construction of the Daniel K. Inouye Solar Telescope (DKIST) is about to start operations on the summit of Haleakala (Maui) increasing the demand for a local workforce, which will affect all existing facilities and projects, including the Maui Space Surveillance Complex and subcontractors that carry out maintenance, operation, and R&D for the Air Force.

**15. SUBJECT TERMS**
Multi-Level Diverse Workforce, Astronomy and Remote Sensing, Akamai Workforce Initiative

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON NACHMAN, ARJE |
|---|---|---|---|---|---|
| a. REPORT | b. ABSTRACT | c. THIS PAGE | | | |
| Unclassified | Unclassified | Unclassified | UU | | 19b. TELEPHONE NUMBER *(Include area code)* 703-696-8427 |

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

DISTRIBUTION A: Distribution approved for public release.

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**PI:** Lisa Hunter (FA9550-15-1-0427)

## 1. HIGHLIGHTS OF PAST YEAR

- 137 total Akamai interns
    - 49 total interns placed on Maui at AFRL, AFRL contractors, remote sensing facilities, and related tech companies
    - > 1/3 interns are women, higher than representation in many of the fields they are in
    - Approximately ¼ of interns are of Native Hawaiian ancestry, which is similar to the fraction in the general state population in the state
- 8 teams from ISEE's Professional Development Program taught at the Akamai PREP course
- 98 Akamai Mentor Workshop participants representing most of Akamai's host organizations
    - Mentors designed project milestones with intern-produced deliverables for assessment purposes
    - Mentors learned "mentoring moves" designed to transfer or maintain ownership of the learning process to the interns
- Paper presented at the American Society for Engineering Education (ASEE) for their annual conference in 2018 reporting on results of longitudinal study and analysis indicating:
    - 87% of alumni persist in STEM (in STEM job or still enrolled in STEM program)
    - Persistence is the same across gender and race/ethnic groups
- Akamai received a Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM), the highest US award for STEM mentoring

## 2. OVERVIEW OF PROJECT

Hawai'i is a vital resource in the fields of remote sensing and astronomy. The summit of Haleakala on Maui includes Mees/SOLARC observatories, the Maui Space Surveillance Complex (MSSC), PanSTARRS, and other facilities. Construction of the Daniel K. Inouye Solar Telescope (DKIST) is well underway on Haleakala. Air Force Research Laboratory Detachment 15 is responsible for the telescope and supercomputer operations of the Air Force Research Laboratory on Maui. A growing number of high tech companies are located on Maui, many engaged as subcontractors, or in research and development in related fields. On the Big Island of Hawai'i, Mauna Kea houses other state-of-the-art astronomical facilities, including the W. M. Keck Observatory, Gemini Observatory, Subaru Telescope, and the NASA Infrared Telescope Facility. The TMT International Observatory has continued to make strides towards construction. Other islands in the state have important technology and remote sensing centers. The Pacific Missile Range Facility (PMRF) is the largest technical employer on the neighbor island of Kauai. *The growing science and technology sector in Hawai'i has an increasing need for a technical workforce to support the building and operation of the above facilities.*

This project addresses workforce challenges in Hawai'i and nationally, through the Akamai Workforce Initiative. Hawai'i is a vital resource for advancing U.S. research, technology and national security, in the fields of astronomy and space situational awareness, but faces ongoing challenges in meeting workforce needs and maintaining productive community relations. The challenge is one that spans multiple fields in science, technology, engineering, and mathematics (STEM), and involves professionals ranging from technicians and engineers hired from the pool of local talent, to the national scientific "user" and instrumentation communities.

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In Hawai'i, workforce development shortfalls have the potential to impede U.S. leadership in astronomy and space surveillance, and the situation exemplifies problems faced by many large, remotely located facilities. Construction of the Daniel K. Inouye Solar Telescope (DKIST) has begun on the summit of Haleakala (Maui) increasing the demand for a local workforce, which will affect all existing facilities and projects, including the Maui Space Surveillance Complex and sub-contractors that carry out maintenance, operation, and R&D for the Air Force.

The Akamai[1] Workforce Initiative (AWI) is an innovative enterprise that supports U.S. astronomy and remote sensing through programs that build a multi-level, diverse workforce. Since its inception, AWI has prioritized inclusion of people from diverse backgrounds, especially those from groups underrepresented in STEM.

## 3. PARTICIPANTS
Led by the University of California at Santa Cruz Institute for Scientist & Engineer Educators (ISEE), participants in AWI includes:
- **University of California, Santa Cruz**, including the Center for Adaptive Optics (CfAO), Laboratory for Adaptive Optics (LAO), Education Department, and University of California Observatories
- **University of Hawai'i**: Institute for Astronomy, Maui College, Manoa, Hilo, Kauai CC, Honolulu CC, Hawaii CC, Kapiolani CC, West Oahu
- **Air Force Research Laboratory Detachment 15/Air Force Maui Optical & Supercomputing Site**
- **National Solar Observatory/Daniel K. Inouye Solar Telescope**
- **Thirty Meter Telescope International Observatory**
- **Maui industry:** Maui High Performance Computing Center, Hnu Photonics, Akimeka, Oceanit, Pacific Defense Solutions, Boeing, Pacific Disaster Center
- **Mauna Kea observatories:** W.M. Keck Observatory, Subaru Telescope, Gemini Observatory, Smithsonian Submillimeter Array, Canada-France-Hawai'i Telescope

## 4. APPROACH
The project continues to use a model for the Akamai Internship Program that was established in 2002, which provides college students with summer projects at observatories and companies in Hawai'i. The goals of the program are to advance local students into the tech workforce, and increase the participation of underrepresented groups in STEM. Akamai has a long-standing success for engaging and retaining underrepresented and under-served populations. Since inception, the program has included **32% of Akamai Internship alumni are community college students, 37% are women, 24% are Native Hawaiians/Pacific Islanders, and more than 45% are from under-represented minority groups.** As in past years, the 2017 Akamai Internship Program included carefully designed components described below.

- **Collaborative Mentoring:** Akamai staff met with prospective mentors to establish an intern project that will be a valued contribution to the mentor's organization *and* a productive educational experience for the intern. This process set the stage for the summer program, when Akamai staff worked with interns and mentors via site visits, weekly check-ins, and close monitoring of progress.

- **Preparatory Course:** Interns practiced working on a team to define and solve problems, design investigations, support solutions, and explain results through a series of inquiry activities designed and taught by participants in the ISEE Professional Development Program. In addition, they practiced informal communication that helped them be successful in the workplace.

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[1] *akamai* – smart, clever, expert

- **Mentored Project:** Interns were guided by their primary mentor, as well as others in the workplace, to complete a 7-week project, specifically designed so that apprentices have ownership. Projects are often in electronics, mechanical engineering, optics, computer programming, information technology, and electrical engineering. Host organizations are below.

- **Communication Course:** Throughout the program, interns completed communication assignments based on their projects, including a 1-minute "elevator talk," a written abstract, and an oral presentation. The course helps Akamai staff assess interns' work (and helps interns self-assess).

- **Symposium:** All interns gave a 10-minute formal oral presentation aimed at a technical audience, and Akamai staff spent an intensive coaching day with interns to assist this process. High expectations are held, and tools and strategies are imparted to help all interns deliver a high quality presentation.

- **Career Development:** After the summer program, intern alumni will be invited back for career development activities (such as workshops). Akamai works with partners to design these activities and provides employers access to highly sought after Akamai alumni. Akamai staff will connect alumni with continuing education and career opportunities, keeping in touch with alumni for many years.

### 5. PROJECT OUTCOMES TO DATE

**2016-19 Interns and Placements**
The interns placed on Maui during the period of this award (2016-19 cohorts) is listed below, organized by intern placement site.

| Last name | First name | Cohort Year | Internship site |
|---|---|---|---|
| Hedglen | Alexander | 2016 | AFRL/MHPCC |
| Ifo | Zachary | 2016 | AFRL/MHPCC |
| Torricer | Derrick | 2016 | AFRL/MHPCC |
| Kim | Chris | 2017 | AFRL/MHPCC |
| LaBonte | Tyler | 2018 | AFRL/MHPCC |
| Hozaki (Yip) | Sherie | 2019 | AFRL/MHPCC |
| Pacheco | Keakealani | 2019 | AFRL/MHPCC |
| Kim | Chris | 2016 | Akimeka LLC |
| Pante | Pauleen | 2016 | Akimeka LLC |
| Lau | Michelle | 2017 | Akimeka LLC |
| Noe | Kurt | 2017 | Akimeka LLC |
| Kaohi | Alexandra | 2018 | Akimeka LLC |
| Peterson | Ariel | 2018 | Akimeka LLC |
| Chen | Alice | 2019 | Akimeka LLC |
| Chin | Jonathan | 2019 | Akimeka LLC |
| Onodera | Brialyn | 2016 | DKIST |
| **Last name** | **First name** | **Cohort Year** | **Internship site** |

| Rioca | Christine Joy | 2016 | DKIST |
|---|---|---|---|
| Noe | Kari | 2016 | DKIST |
| Paikai | Keanu | 2016 | DKIST |
| Colon | Nicolas | 2017 | DKIST |
| Kiessner | Chantelle | 2017 | DKIST |
| Svetin | Erik | 2018 | DKIST |
| Bolusan | Jett | 2019 | DKIST |
| Cotton | Dashiell | 2019 | DKIST |
| Jefferson | Katherine | 2019 | DKIST |
| Smith | Walter | 2019 | DKIST |
| Urasaki | Chase | 2019 | DKIST |
| Yoshida | Kyle | 2016 | Hnu Photonics |
| Abella | Maveric | 2016 | Hnu Photonics |
| Nishimoto | Corin | 2018 | Hnu Photonics |
| Ooki | Maya | 2018 | Hnu Photonics |
| Abella | Terric | 2019 | Hnu Photonics |
| Yoshimura | Dayna | 2019 | Hnu Photonics |
| Ashcraft | Jaren | 2016 | Institute for Astronomy, Maui |
| Hashimoto | Joey | 2016 | Institute for Astronomy, Maui |
| Liu | Brandi | 2017 | Institute for Astronomy, Maui |
| Parep | Joshua | 2017 | Institute for Astronomy, Maui |
| Massad | Keoki | 2017 | Institute for Astronomy, Maui |
| Spetich | Michael | 2017 | Institute for Astronomy, Maui |
| Bayer | Alec | 2018 | Institute for Astronomy, Maui |
| Lee | Ethan | 2019 | Institute for Astronomy, Maui |
| Balinbin | Gregory | 2016 | Integrity Applications Inc/Pacific Defense Solutions |
| Todoki | Ariel | 2017 | Integrity Applications Inc/Pacific Defense Solutions |
| Song | Sae Hyun | 2018 | Integrity Applications Inc/Pacific Defense Solutions |
| Dinh | Queenique | 2019 | Integrity Applications Inc/Pacific Defense Solutions |
| Lau | Jenna | 2019 | Integrity Applications Inc/Pacific Defense Solutions |
| Craig | Brianna | 2017 | UH Maui College/NOAO |
| Yuen | Matthew | 2017 | Pacific Disaster Center |

**Selection and Placement of 2016-19 Akamai Interns**

A selection committee consisting of mentors from most host organizations, as well as Akamai staff was convened to select and place students with mentors/projects. This process is time-consuming but is an essential ingredient to the success of the program. Students are placed with project for which they have the required skills and background, and will be challenged by the projects.

Internship Highlights

Every intern completes a mentored project during the program that is a valuable contribution to the host site but also a very educational experience for the student. The interns work with mentors who are experts in the same field the students are interested in. As noted above, a high fraction of interns secure employment after their internship, or continue into graduate programs. Two examples of interns are below:



## Akamai Project Examples

Laurie Hozaki (2010 intern)
Grew up on Maui
Was a **UH Maui College student** majoring in electronics when accepted to Akamai
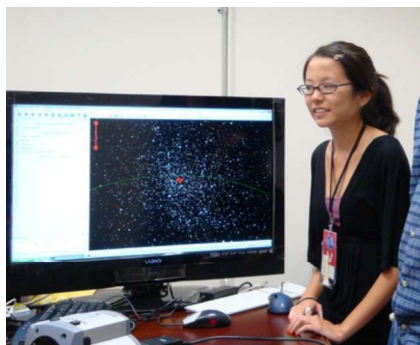
**Akamai Project:** Building a Daytime Satellite-Tracking Telescope System – Camera System Integration
**Project site:** **Pacific Defense Systems (PDS)**

**Laurie is 1 of 6 Akamai alumni that now works at IAI/PDS**

Tyler Lebonte (2018 intern)
Mililani High School graduate
**University of Southern California** student, majoring in Computer Science

**Akamai Project:** TensorFlow Distributed Image Serving: A lightweight, RESTful remote inference library for decoupling deep learning model development and application
**Project Site:** **Air Force Research Laboratory (AFRL)**
**Mentor:** Capt. Justin Fletcher

**Expanding capacity through effective mentoring**

A new mentoring workshop has already been developed (funded by NSF AST#1347767 and by TMT). This workshop was further refined during this award, and offered to all mentors participating in the Akamai Internship Program. Participants in the 2016-19 Akamai Mentor Workshop, from Maui sites, are listed below.

| First Name | Last Name | Mentor Workshop Year | Company |
|---|---|---|---|
| Richard | Peterson | 2019 | AFRL/MHPCC |
| Ryan | Swindle | 2017 | AFRL/MHPCC |
| Justin | Fletcher | 2017 | AFRL/MHPCC |
| Paul | Schumacher | 2016 | AFRL/MHPCC |
| Joey | Andrews | 2016 | Akimeka LLC |

| First Name | Last Name | Mentor Workshop Year | Company |
|---|---|---|---|
| Peter | Konohia III | 2019 | Akimeka LLC |
| Desislava | Iorgova | 2017 | Akimeka LLC |
| Lisa | Burleson | 2019 | ASRC Federal/Akimeka |
| Rob | Nelson | 2018 | ASRC Federal/Akimeka |
| Lance | Leber | 2019 | DKIST |
| Mackenzie | Stratton | 2019 | DKIST |
| Brialyn | Onodera | 2018, 2019 | DKIST |
| Guillermo | Montijo Jr | 2016 | DKIST |
| Christopher | Gedrites | 2019 | DKIST |
| Stephen | Guzzo | 2019 | DKIST |
| LeEllen | Phelps | 2016 | DKIST |
| Andre | Fehlmann | 2016, 2019 | IfA Maui/DKIST |
| Tom | Schad | 2016, 2017 | DKIST |
| Stacey | Sueoka | 2017 | DKIST |
| David | Harrington | 2016, 2017, 2019 | DKIST |
| John | Hubbard | 2016 | DKIST |
| Mary | Liang | 2016 | HNu Photonics |
| Caitlin | O'Connell-Rodwell | 2016 | HNu Photonics |
| Sylvia | Loh | 2018, 2019 | HNu Photonics |
| Brittany | Willbrand | 2019 | HNu Photonics |
| Devin | Ridgley | 2016 | HNu-Photonics |
| Cynthia | Giebink | 2017 | Institute for Astronomy Maui |
| Jeff | Kuhn | 2017, 2019 | Institute for Astronomy Maui |
| Dennis | Douglas | 2017 | Integrity Applications Inc |
| Rob | Bartlett | 2016 | JaKris/Akimeka |
| Channing | Chow | 2019 | Pacific Defense Solutions |

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## Professional Development of Early Career Scientists & Engineers

AWI has used the infrastructure of ISEE's Professional Development Program (PDP) as a platform to address workforce development needs at the post-graduate to early career levels, while simultaneously applying their training to prepare Akamai interns for their coming internship experience. The PDP trains early-career scientists and engineers (primarily graduate students, from a range of STEM disciplines) to teach and mentor effectively through a suite of workshops that focus on how to teach problem solving and research skills and how to create learning and working environments that support retention in STEM. The PDP also includes a practical teaching experience – a crucial component of effective professional development,[1] and which for some is carried out within the Akamai preparatory course.

The PDP is a key component of AWI's workforce development model.[2] It fuels Akamai programs with an ongoing supply of effective educators, while training the next generation. The PDP also supports the dissemination of successful Akamai strategies to new partner sites. Figure 3 below shows the established yet innovative model that integrates ISEE programs and AWI components described above, making the value of these components much more than the sum of the parts. The integration of components is key to the initiative's success and is what sets Akamai apart from other programs.
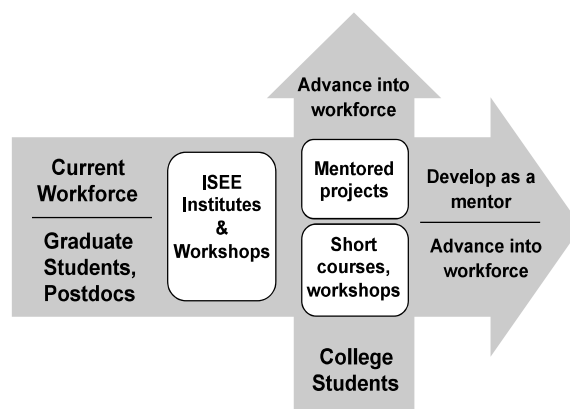


**Figure 3.** Model showing how ISEE and AWI programs are integrated.

## Results from Longitudinal Study of Akamai Alumni

Every 2-3 years Akamai staff conduct a longitudinal study of Akamai alumni since the inception of the program. Alumni are sent a survey, which about 50% complete, and then Akamai staff track down as many of the remaining alumni as possible. Though this is a painstaking process, the effort is well worth it. Akamai was able to find 82% of alumni since the program's inception in 2003. Responses from alumni are then coded, and analyses performed to establish the statistical significance of the outcomes.

In 2018 we published the results of our study[3], and some of the most important outcomes from this study are summarized below:

- **Retention in STEM:** The program has had impressive results for retaining and advancing college students into STEM careers. **Over 85% of alumni remain on a STEM education or career pathway[4], with 140 alumni now in STEM jobs, many in Hawai'i.** Studies indicate that nationally, fewer than 40% of those intending to pursue a STEM degree in college actually earn a STEM degree[5] and for some groups retention rates are as low as 20%.

- **Alumni of all ethnicities and both genders retained at same rate:** With support like that

| Akamai alumni 3 years after completing the program | Total (n=222) |
|---|---|
| Intern alumni located | 82% |
| percentages below calculated from alumni located | |
| A. Now in STEM workforce | 70% |
| B. Enrolled in undergrad or grad STEM program | 17% |
| C. All on STEM pathway (A+B+C) (women) (Native Hawaiians/Pacific Islanders) (all underrepresented minorities) | 87% (82%) (84%) (86%) |

Akamai provides, students of all backgrounds persist at high rates, including those that nationally have

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persistence rates as low as 20%.[5] This result points to the pivotal role of the college STEM experience in retention, and brings into question the widely held view that college is "too late" to change the demographics of STEM.

- **GPA (in the A-C grade range) was not correlated with STEM persistence:** This finding highlights the limitations of judging students' potential to be successful in the STEM workforce, based on grades. Academic performance can be affected by biases and beliefs, such as stereotype threat.[6] Akamai supports and recognizes performance in authentic STEM contexts, and provides access to STEM careers for students who might otherwise be overlooked.
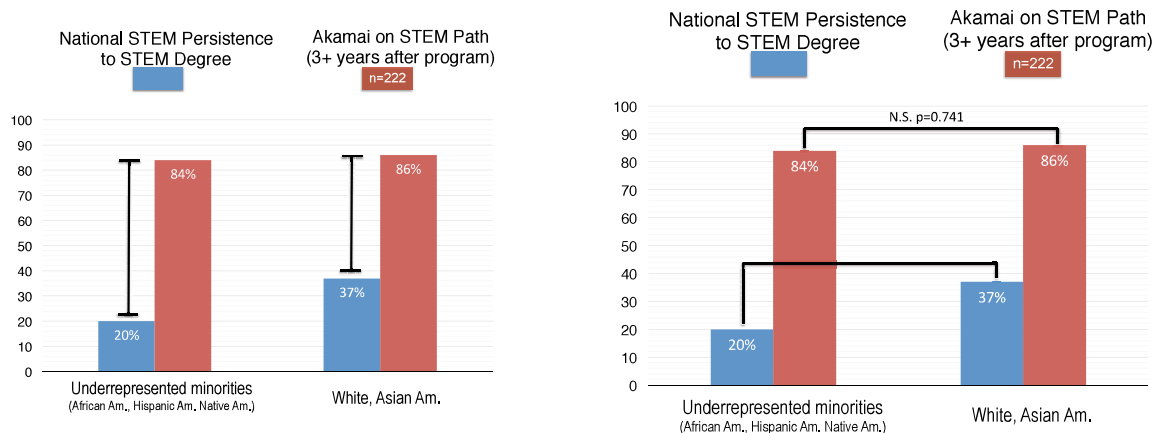


Akamai is a carefully designed program, informed by research, which includes the following major thematic areas:

- Engaging interns in authentic engineering practices
- Promoting intern ownership and agency over the project
- Enabling an intern's positive STEM identity
- Developing an intern's sense of belonging and social capital
- Encouraging an intern's growth mindset by integrating formative assessment into mentored projects

These thematic areas are embodied throughout the program, and are now being incorporated into the mentor workshop as a means of translating best practices to a broader community and expanding the impact of Akamai.

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In 2018 Akamai received a Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring (PAESMEM), the highest US award for STEM mentoring



PI Lisa Hunter and Co-PI Jerome Shaw receiving the PAESMEM award. Washington DC, June 2018.

## REFERENCES

[1] Center for Public Education (2013) "Teaching the Teachers: Effective Professional Development in Era of High Stakes Accountability"

[2] Inverness Research, Inc. (2014) "The UCSC Institute for Scientist & Engineer Educators: Supporting Multi-Level STEM Workforce Development" Inverness, California

[3] Barnes, A., & Ball, T., & Starr, C. R., & Seagroves, S., & Perez, K., & Hunter, L. (2018, June), Successfully Building a Diverse Telescope Workforce: The Design of the Akamai Internship Program in Hawai'i Paper presented at 2018 ASEE Annual Conference & Exposition, Salt Lake City, Utah. https://peer.asee.org/31030

[4] Hunter, L. (2010) "Outcomes from the CfAO Research Internship Program." http://cfao.ucolick.org/CFAO-internship-outcomes.pdf

[5] President's Council of Advisors on Science and Technology, Feb. 2012. "Engage to Excel: Producing One Million Additional College Graduates With Degrees in Science, Technology, Engineering, and Mathematics." http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_2-25-12.pdf from http://www.whitehouse.gov/administration/eop/ostp/pcast/docsreports

[6] Many references on "stereotype threat" are at: http://reducingstereotypethreat.org

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