Board 18: Work in Progress: The ATP-Bio REU Boot Camp: An Innovative Approach to Building a Sense of Community in Support of Broadening Participation in Biomedical Engineering

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Dr. Thompson is the current Engineering Workforce Development Program Manager for ATP-Bio and has previously held faculty appointments in the Department of Biology Teaching and Learning at the University of Minnesota and on the Faculty of Engineering and Science at the University of Agder in Kristiansand, Norway. His published work includes papers on innovative approaches to undergraduate research, equitable science education, and professional development for early career scientist.

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I am pursuing my PhD in psychological foundations of education, specifically, learning and cognition. I am currently conducting research on using what we know about expert problem-solving for improving novice persistence in the face of failure, and separately how different types of feedback affects student programming outcomes and computing attitudes. My research interests involve learning how to make science more accessible and equitable by helping students develop a positive and inclusive scientific identity, while also building skills in educational and organizational program evaluation.

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Introduction

As science, technology, engineering, and mathematics (STEM) fields have become a larger part of the United States economy, the education system has struggled to train enough STEM professionals to keep up [1,2]. This has been compounded by persistent inequity within STEM fields, which limits access to participation for many communities. While interest in STEM careers is high among students from many different backgrounds [3], engineering as a subfield is still primarily composed of white men [4]. Barriers to participation and an exclusionary culture [5-11] has led to high attrition rates in STEM fields, particularly for racial minority students [12]. For example, in engineering, Black, Latino, and American Indian persons account for only ~14% of the Engineering workforce [13] despite comprising ~34% of the US population [14].

Given this context, much research has been dedicated to understanding effective methods for retention of underrepresented students in STEM. Undergraduate research programs have been shown to increase STEM degree completion [13,14] and positively impact academic performance and persistence in STEM [15,16]. However, access to these continues to be limited at many institutions and community colleges, thereby missing a largely untapped potential for broadening participation in STEM careers [15,16]. Creating strong (and mutually beneficial) partnerships between research intensive universities and community colleges represents a promising path forward for broadening access to research experience for community college students and broadening participation in STEM fields [17].

The National Science Foundation Engineering Research Centers (NSF ERC) program is a major piece of infrastructure supporting undergraduate research in engineering fields. Each ERC is expected to host an annual summer research experience for undergraduates (REU) program and the unique multi-institutional nature of the ERCs provides an unparalleled opportunity to support new strategies for broadening participation in engineering. However, ERC REUs are often more distributed than traditional models, which can present challenges for building a strong sense of community within the REU cohort. Given the importance of establishing this sense of belonging to promote retention of underrepresented minority students, we developed a two and half day orientation workshop to our ERCs REU program that brings all participants together for a shared onboarding experience and community building before they move to their respective institutions for the summer research experience. In this paper, we describe our approach to the design of this shared experience and report early results from our programmatic evaluation.

Methods

Rationale for Development

In 2023 we introduced a novel expansion to the center's summer program, the ERC REU Boot Camp. The Boot Camp stemmed from student evaluations of the first two years of REU programming offered, which placed students at two different research institutions across the country, with opportunities for weekly virtual engagement. While these participants reported that their research experiences were highly impactful for their personal and professional development, they also reported that the sense of community *across the sites* was lacking. As we looked to expand our programming to include five different research institutions to place

students, we know actively promoting this sense of community across all REU participants would be imperative to the success of our programming.

Key Design Features

The primary goal of the Boot Camp is to actively build a community of undergraduate researchers that have a strong sense of belonging to the center and a sense of community among each other. To accomplish this, we split activities into three foci: teaming building activities; orientation to the center's science; and professional development. The Boot Camp is held in person and team building started on the first day with a hosted dinner and reception that emphasized building social connection. All participants, including program staff, graduate student mentors, and REU students were included in the social outing. Each day included additional team building activities during the meal times and a structured free time on the third day. Orientation of the center's science was accomplished by a presentation (led by the mentors) on the principles of cryopreservation, an introduction to the ERC mission, structure, and research portfolio, and a tour of labs at UC-Riverside. The mentors also led a period of hands-on activities for the REU students to engage in the center's methodologies. Finally, professional development was facilitated through a number of workshops and panels with REU program alumni and project mentors. A full agenda from the first iteration is provided in Appendix 1 below.

Evaluation and Feedback

To evaluate the boot camp experience, participants were asked to rate their experience in three ways: 1) Quality of Presentations given at the boot camp, 2) Effectiveness of the boot camp in promoting a sense of community, and 3) Open ended feedback to improve the boot camp in future iterations. The full feedback survey is provided in Appendix II. This study was reviewed and deemed exempt by the University of Minnesota IRB under STUDY00009659

Results

14 of the 17 participants filled out the evaluation survey, which was delivered electronically the day after the boot camp was completed. Feedback on the boot camp was overwhelmingly positive with all participants rating the instructors as "excellent" and all participants "strongly agreeing" that the instructors displayed personal interest in students and motivated students to learn. Individual boot camp activities were rated highly by participants, with the lowest rated activity scoring a 4.64 out of 5.0. Similarly, participants strongly agreed that the boot camp was effective in creating community and making them feel valued as participants. Mean values for student responses to each survey item are provided in Table 1.

In the open ended comments section, participants expressed a high degree of appreciation for the boot camp experience and suggested that it was helpful for building their sense of connectedness with the center and understanding of center activities. For example, one participant commented, "I believe that the boot camp really helped me learn more about how all of our roles actually come together." Other comments also demonstrated the boot camp's contributions to building a sense of community among REU participants, such as "I really enjoyed the boot camp and the opportunity we had to all meet each other despite being located at different sites." In comparison to previous years, we saw this sense of community continue on throughout the summer program through more consistent and active participation in the weekly virtual sessions throughout the

summer. Suggestions for improvement centered on increased logistical preparation to make transitions smoother and a suggestion for more interactive lab tours.

Table 1. Mean student response on a scale of 1-5 for each boot camp evaluation question

Section 1 *Rate the following experiences from very poor (1) to excellent (5)*		N=14
Survey Item	Mean Score	
Overall, I would rate the instructors as:	5.0	0.00
DAY 1: Being a Researcher	5.0	0.00
DAY 1: Welcome to ATP-Bio and Center Overview	4.64	0.74
DAY 1: ATP-Bio Research Overviews Part I	4.93	0.27
DAY 1: ATP-Bio Research Overviews Part II (hands on)	4.79	0.43
DAY 1: REU Alumni Panel	4.93	0.27
DAY 1: How to Read a Scientific Paper	4.79	0.43
DAY 2: Lab tours	4.64	0.63
DAY 2: Ethical Lab and Data Practices	4.93	0.27
DAY 2: Scholar Panel	4.86	0.53
Section 2 *Rate the following experiences from very poor (1) to excellent (5)*		
Survey Item	Mean Score	
The instructors displayed personal interest in students…	5.0	0.00
I felt welcomed and included:	4.93	0.27
The boot camp experience was interesting to me:	4.86	0.53
Complexity and workload were reasonable:	4.79	0.43
The boot camp provided me with a basic understanding….	4.71	0.47

Conclusions

The first iteration of the REU Boot Camp was a success in producing a cohort of 17 students (see Appendix III) spread across 5 research institutions that maintained a sense of belonging and community over the 10-week program. This conclusion was supported by post program evaluation in which students conistented referenced the bootcamp as an impactful part of their REU experience. We will build on this momentum by offering a Boot Camp experience each year to build relationships across sites that will help invite more interactions with each other during the summer program and strengthen the convergent nature of the REU research experience. Future efforts will continue to probe how this individual experience, coupled with repeated opportunities for virtual community building, can create sustained relationships among REU participants that promote a positive culture of inclusion and increased retention of students in the cryopreservation workforce.

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Appendix 1 : Boot Camp Agenda

Day 1: Bio-preservation Boot Camp Kickoff and Course Instruction	
8:00 AM	Transportation pick-up
8:30AM	Breakfast UCR | Highlander Union Building 269
9:00 AM	**Intro to Research:** Being a Researcher - Dr. Chris Hogan
10:00 AM	**Welcome to ATP-Bio and Center Overview** – Dr. John Bischof
10:30AM	**ATP-Bio Research Overviews Part I**
12:00 PM	Lunch |
1:15 PM	**Institutional Training Administrative Breakout**:
1:45 PM	**ATP-Bio Research Overviews Part II** - Activity rotations
2:45PM	**REU Alumni Panel Q&A** - REU Alumni
3:30PM	**Intro to Research**: How to Read a Scientific Paper
6:00 PM	Dinner | Palenque by Mezcal

Day 2: Bio-preservation Boot Camp Course Instruction and Conclusion	
8:00 AM	Transportation pick-up
8:30 AM	Breakfast UCR | Winston Chung Hall 205/206
9:00 AM	**Bio-preservation Lab Tours** Group A - Yin Lab | ROOM 307 Group B - Mangolini Lab | MSE 259
10:00 AM	**Bio-preservation Lab Tour** Group B - Yin Lab | ROOM 307 Group A - Mangolini Lab |MSE 259
12:00 PM	Lunch | UCR - **ATP-Bio Pillar Leadership Meeting**
1:30PM	**Scholar Panel - Trainees** Transferable career skills, trajectories, open Q&A discussion
2:30PM	**Intro to Research:** Ethical Laboratory and Data Practices - Dr. Hogan
3:15 PM	**Intro to Research**: How to Keep a Lab Notebook - Dr. Ishan Goswami
4:00 PM	**Explore Riverside**: Hike to Mt. Rubidoux
6:00 PM	Dinner | Mission Inn Restaurant
7:30 PM	Social | Organized on site

Appendix II. Evaluation Survey

Section 1: Please rate the following experiences

	Excellent	**Good**	**Fair**	**Poor**	**Very Poor**
Overall, I would rate the instructors as:					
DAY 1: Being a Researcher					
DAY 1: Welcome to ATP-Bio and Center Overview					
DAY 1: ATP-Bio Research Overviews Part I					
DAY 1: ATP-Bio Research Overviews Part II (hands on)					
DAY 1: REU Alumni Panel					
DAY 1: How to Read a Scientific Paper					
DAY 2: Lab tours					
DAY 2: Ethical Lab and Data Practices					
DAY 2: Scholar Panel					

Section 2

	Strongly Agree	**Agree**	**Undecided**	**Disagree**	**Strongly Disagree**
The instructors displayed personal interest in students and motivated students to learn:					
I felt welcomed and included:					
The boot camp experience was interesting to me:					
Complexity and workload were reasonable:					
The boot camp provided me with a basic understanding of					

biopreservation that will help prepare me for my summer research experience:					

Section 3:
Please take a moment to share any feedback that might help planners to improve the ATP-Bio boot camp.

Appendix III

Table 1 : Home Institutions of REU Boot Camp Participants.

Institutions	Institution Type	# of Participants
	Community College	8/17 (47%)
	Attends Minority Serving Institution (MSI)	10/17 (65%)
Macalester College		1
Harvard University		1
Cerritos College	Community College. MSI	1
Victor Valley College	Community College. MSI	3
Irvine Valley College	Community College, MSI	3
Fort Lewis College		1
Goshen College		1
Scripps College		1
University of Hawaii at Manoa	MSI	1
Vanderbilt University		1
Johns Hopkins University		1
Rutgers University New Brunswick		1
Century College	Community College, MSI	1

Table 2 : Undergraduate Majors of Participants

Primary Major	# of Participants
Biomed Eng	**2**
Cell and Molec	**2**
Chem/ Chem Engineering	**2**
Physics	**1**
Biology	**10**

Table 3: Self-reported Gender of REU Participants

Gender	Count
Women	12
Men	5