Empowering scholars to change the culture of STEM pedagogy to be more inclusive and equitable

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Dedicated to Dr. AKM Newaz
My Path

Columbia, MD
Philadelphia, PA
Chicago, IL
San Francisco, CA
SF State

- Hispanic-serving, master’s granting, ~27,000 students
- Long history of student-led social justice
- Diverse racial/ethnic demographics:

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<thead>
<tr>
<th>Race</th>
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<tbody>
<tr>
<td>Hispanic</td>
<td>30%</td>
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0% 5% 10% 15% 20% 25% 30% 35%
Inclusive Teaching, Mentoring, and Communities of Practice

Treat people like the amazing, full human beings they are!
Resources

🌟 Inclusive Astronomy
🌟 AAS: Diversity and Inclusion in Graduate Education
🌟 AIP: TEAM-UP
🌟 AAAS: SEA Change

+ so many others to see at AAPT/PERC!
Gutierrez Framework

“Playing the game” and “Changing the game”

Relationships and tensions between: Access, Achievement, Identity, Power
Yosso: Community Cultural Wealth
Estrada, Eroy-Reveles, Matsui

**Fig. 1.** Definition of macro and micro aggression and affirmation of social inclusion.

**Fig. 2.** Progression to an inclusive institutional environment.
Projects

- Diverse environments that support values of equity and justice
- Recognize assets and celebrate strengths; address students’ goals, interests, values, needs
- Become scientists by doing science and being part of a scientific community

- Pedagogy Course for Graduate TAs
- Pedagogy Course for Learning Assistants and other Undergraduate Peer Mentors
- Communities of Practice for Faculty
SF State Physics & Astronomy

Introductory Courses:
- Conceptual Physics
- Algebra-based Physics I, II
- Calculus-Based Physics I, II, III
- General Education Introductory Astronomy

Curriculum reform: guided-inquiry labs
Alma project: reflective journaling

Per semester:
- Up to 7 lecture sections and 14 lab sections for each course
- Lecture sections have 50 – 150 students, labs up to 30 students
- Labs taught by GTAs, NTT “lecturer” faculty
- ~1400 students, 60 lab sections total
Pedagogy Courses
GTA Pedagogy Course

Goals
- Apply evidence-based, student-centered STEM teaching strategies.
- Reflect on teaching practice, including successes and challenges.
- Help peers identify successes and challenges in their teaching.
- Become familiar with and implement approaches to teaching and learning that include equity considerations.

Course Components
- Class Participation
- Weekly Reflection Essays
- Weekly Prep
- Peer Observations
- Action Research Project

Readings
- How Learning Works by Ambrose et al. (2010)
- Articles on equity and inclusion, e.g. Estrada et al. (2018), Gutiérrez (2009), Yosso (2005), etc.
GTA Pedagogy Course

Topics

- Ground rules (community agreements)
- Fundamentals (2 weeks)
- Equity (2 weeks)
- Prior knowledge
- Knowledge organization
- Motivation
- Developing mastery
- Practice and feedback
- Course climate, student development, ambient belonging
- How students become self-directed learners
- Future goals

Projects

- Intro to PER
- IRB training
- Abstract
- IRB proposal
- Peer review
- Analysis check-in
- Presentation
Impacts

Student surveys

GTA surveys, interviews
PM reflections, interviews
Faculty reflections, interviews
Belonging

Have you ever felt like you didn’t belong?

• Students who feel a sense of belonging in their STEM courses are more likely to remain in STEM.

• Many students from marginalized groups experience micro-aggressions, stereotype threat, and lack of support from their instructors.

• Due to this lack of inclusion, students navigate with expectations that their identities and life experiences are not valued in STEM spaces.

• When students are forced to disregard their life experiences and identities, it dehumanizes them, creating barriers.
Physics Student Survey Themes

What factors about the lab contributed most to your sense of belonging in a scientific environment?

Inter-personal relationships

Fall 2019
### SPSI: confidence

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**Table:**

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<td>I can use scientific knowledge to form a question.</td>
<td>I can design a scientific procedure to answer a question.</td>
<td>I can communicate a scientific procedure to others.</td>
<td>I can use science terms to share my results.</td>
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**Legend:**

- **strongly disagree**
- **disagree**
- **neutral**
- **agree**
- **strongly agree**
Benefits of Reflective Journaling in Lab

**SPRING 2021 POSITIVES (Internal Feelings)**

- Self Reflection
- Reflection-Thought
- Understanding Self
- Reflection-Feelings
- Reflection-Values
- Reflection-Education

**SPRING 2021 POSITIVES (Professional Life)**

- Stress relief
- Reminder of Purpose
- Self Improvement
- Motivation
- Writing is Nice
- Sense of Belonging
- Improved Scientific Self-efficacy
- Improved Scientific Identity

**SPRING 2021 POSITIVES (Interpersonal Feelings)**

- Interpersonal Relationships - Community
- Having a Voice
- Relating Science to Life
- Reinforce Concepts
- Interpersonal Relationships - Instructor
- Impacting Others
- Interpersonal Relationships - Groups
- Self Expression

**Overall Results**

- TOTAL POSITIVES
- TOTAL NEGATIVES
- TOTAL MIS
Intro CS Student Survey Themes

responses to the question “What aspects of the discussion section have contributed most to your sense of belonging in a CS environment?”

- Section Participation: 1.82%
- Other: 6.06%
- Groupmates: 7.27%
- Neutral: 8.48%
- Content: 15.76%
- Discussion Leader: 18.18%
- Self: 46.06%
- Classroom: 0.61%

responses to the question “Has your sense of belonging in the CS community ever been challenged (made you feel like you didn’t belong)? If yes, please give an example of a time you felt this way, and why.”

- Non CS-specific: 1.21%
- Marginalization: 4.24%
- Interpersonal Relationships: 8.48%
- Lack of science identity/interest: 13.94%
- Low perceived competence: 18.18%
- Course content: 0.00%
GTAs: Methods for Inclusiveness

- Have you ever taken a teaching pedagogy class or workshop or had any formal training in teaching? If yes, have you used any of the skills you learned in teaching SFSU labs?
- Do you spend time considering your students' sense of belonging in the physics classroom? Do you ever act on those thoughts? If so, how?
- Do you make an active effort to improve on/maintain a good dynamic for individual groups? Please explain anything specific you do to help groups work cohesively together.
“I also do things like I don't curve my grades because, you know I don't want to breed a sense of ‘oh I have to compete against these people’. No. You should all be lifting each other up... I have them generate their ground rules on the first day. And I kind of synthesize that, write it up and say hey this is what you have all agreed on.” – Lecturer Interview, Summer 2018
GTA Mindsets and Practices

- Growth/Fixed mindset towards students
- Growth/Fixed mindset toward themselves as instructors
- Asset/Deficit model toward students
- Acknowledgment for the need for equitable teaching practices
- Equitable teaching implementation
Sebastian the Motivated Novice
- **Primary Motivation**: Interest in teaching as a personal growth opportunity, enjoys sharing their knowledge/interest in science
- **Secondary**: Financial benefit

Joel the Passive Scholar
- **Primary Motivation**: Financial support
- **Secondary**: Desire to strengthen their own knowledgebase

Mariela the Empathizer
- **Primary Motivation**: Mix of practical reasons (e.g. financial, relevant experience, solidifies content knowledge) and empathy for students
- **Secondary**: Enjoys teaching

Alexis the Experienced Seeker
(Lecturer/Advanced GTA only)
- **Primary Motivation**: Interested in teaching, usually from prior experience
- **Secondary**: Wants to interact with students
Lab Instructor Personas

- Sebastian
- Joel
- Mariela
- Alexis

= Interview
= Survey
<table>
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<th>Persona</th>
<th>Propensity for inclusive teaching</th>
<th>Likely Areas for Growth</th>
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</table>
| Joel the Passive Scholar    | Many times unaware of the need for equitable teaching; Often does not believe equity issues are present in their classroom                                                                                                               | Yes Growth Mindset - Students
                                    |                                                                                                                | Yes Growth Mindset - Instructor
                                    |                                                                                                                | Yes Asset Model
                                    |                                                                                                                | Yes Familiarity
                                    |                                                                                                                | Yes Implementation |
| Sebastian the Motivated Novice | Understands the need for equity; Many times draws on positive experiences as an undergraduate student                                                                                                                          | Yes Growth Mindset - Students
                                    |                                                                                                                | Yes Growth Mindset - Instructor
                                    |                                                                                                                | Yes Asset Model
                                    |                                                                                                                | Yes Familiarity
                                    |                                                                                                                | Yes Implementation |
| Mariela the Empathizer       | Feels empathy for students; May have prior lived experience with equity issues                                                                                                                                                       | Yes Growth Mindset - Students
                                    |                                                                                                                | Yes Growth Mindset - Instructor
                                    |                                                                                                                | Yes Asset Model
                                    |                                                                                                                | Yes Familiarity
                                    |                                                                                                                | Yes Implementation |
| Alexis the Experienced Seeker | Recognizes need through experience with teaching                                                                                                                                                                                  | Yes Growth Mindset - Students
                                    |                                                                                                                | Yes Growth Mindset - Instructor
                                    |                                                                                                                | Yes Asset Model
                                    |                                                                                                                | Yes Familiarity
                                    |                                                                                                                | Yes Implementation |

Key identifying characteristics and likely areas of growth for each persona
Themes by Persona

Joel the Passive Scholar
Pre (N=5)  Post (N=8)

Sebastian the Motivated Novice
Pre (N=2)  Post (N=7)

Mariela the Empathizer
Pre (N=3)  Post (N=5)

Alexis the Experienced Seeker
Pre (N=2)  Post (N=4)

- Didn't notice/feels it is absent
- Noticed but no action taken
- Other
- Basic teaching practices
- Set an example
- Affirmations
- IR-Instructor/Student
- IR-Classroom
- IR-Group
- Effort, Non-specific
Benefits for Mentors, GTAs, Faculty
Undergrad PM Pedagogy Class Benefits

- Positive Pedagogy Environment
- Pedagogy Class Helpful
- Text Helpful
- Classroom Benefits
- Applied Pedagogies Outside

Legend:
- LAs - In Person (N=9)
- LAs - Online (N=6)
- DLs - In Person (N=14)
- DLs - Online (N=8)
- PINCs - Total (N=6)

Frequency
GTA Benefits - Quotes

Becoming a better teacher and learner

I learned a lot in this course that will help me become a better student and teacher. I think anyone who is doing any teaching in their future should take this kind of course.

Worthwhile and rewarding class

Most of our work was on our own labs and our experiences, and this felt rewarding and challenged me to do better in my lab as a result.

Value of discussion

Safe and engaging space for everyone to share their thoughts and experiences

Feeling heard and validated was extremely helpful.

This course was very well made. I enjoyed the discussion format, and how we, the students, steered and directed the course.

Good job of guiding the class through discussions and getting us to do most of the exploring rather than just being given a lecture or being told how to interpret different ideas.

More unique than your typical physics courses, as it is much more collaborative and is meant to be a place for GTAs to reflect on and build on our teaching styles in lab courses that we are or will be teaching.
Faculty Community Benefits - Quotes

Community | Best practices | Snacks!!

- The community I have gained
- Connections with other instructors that share my interest in developing inclusive classroom environments
- Getting a chance to discuss the pedagogy materials with other instructors
- Participating in the community of practice has been a real delight
- Interactions with other departments ... see new people and share ideas
- I found our discussions about motivation and the effects of environment, efficacy, and value on motivation to be transformative in how I approach creating a classroom environment.
- Reinforced the value of interactive and student-centered approaches. Incorporating small group projects and assignments has improved student engagement and comprehension.
- I have already started implementing what I have learned into practice.
- Knowing what I know now, [I saved] myself a lot of time and stress.
Discuss!

🔹 What are some of the strengths and values of your students? Faculty?

🔹 How can you leverage this?

🔹 What strategies have you used to create a welcoming environment for all?

🔹 What strategies have you used to develop sense of belonging?

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