

Building and Measuring STEM Sense of Belonging through Cultural Responsiveness



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Societal Impact





Dr. Judy Marquez Kiyama

Co-PI, Title III HSI STEM Project *CREAR*
Professor, Educational Policy Studies &
Practice; College of Education



Kimberly Sierra

PI, Title III HSI STEM Project *CREAR*
Director of Undergraduate Research &
Inquiry,
Office of Societal Impact and
Co-Director, STEM Learning Center



Andrea Palacio, M.Ed.

Senior Coordinator
CREAR STEM Learning Communities
Office of Societal Impact

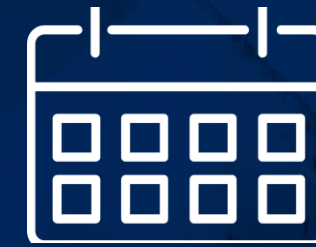


Christopher Oka, M.Ed.

Curriculum & Training Manager
CREAR STEM Learning Communities
Office of Societal Impact



We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.



Today's Agenda

Welcome & Introductions

Background of Project CREAR

Frameworks:

Cultural Responsiveness

Sense of Belonging

Culturally Responsive CURES

Culturally Responsive Curriculum Development Institute

STEM Learning Communities

Partnering across STEM

Discussion and Q & A



PURPOSE OF THE TITLE III HSI STEM

The purpose of the Hispanic-Serving Institutions - Science, Technology, Engineering, or Mathematics (HSI STEM) and Articulation Programs is to:

- “
- (1) increase the number of Hispanic and other low-income students attaining degrees in the fields of science, technology, engineering, or mathematics; and
 - (2) to develop model transfer and articulation agreements between two-year and four-year institutions in such fields.

U.S. DEPARTMENT OF EDUCATION WEBSITE

UArizona's Title III HSI STEM: Project CREAR is 94.1% funded through the U.S. Department of Education Hispanic Serving Institutions STEM and Articulation Program, Title III, Part F, for the amount of \$4,989,496.00 across a five-year award period and 5.9% funded through the University of Arizona for the amount of \$313,302 across a five-year period.

A Humanizing Evolution of Cultural Responsiveness



Culturally Relevant

- Validation; integrating prior knowledge of students into curriculum

(Ladson-Billings, 1995; Lee, 2017; Moll, Amanti, Neff, & Gonzalez, 1992)



Culturally Responsive

- Incorporates attributes of & knowledge from students' cultural backgrounds into content to improve their academic achievement.
- Sociopolitical & Critical Consciousness

(Gay, 2002; Howard, 2012; Ladson-Billings, 1995)



Culturally Sustaining

- Focus on sustaining linguistic, literate, & cultural pluralism, sustain culturally inherited ways of navigating the world to move towards social transformation and liberation.

(Alim & Paris, 2017; Lee, 2017; Paris & Alim, 2014)

SENSE OF BELONGING & LATINE/X STUDENTS

- Concept of sense of belonging often attributed to Hurtado and Carter's (1997) scholarship with extensive development by T. Strayhorn (2008, 2012, 2018)

Sense of belonging is:

- Feeling respected, valued, and included.
- Meaning making, connectedness, and mattering.
- Directly connected to cultural validation (see validation theory and funds of knowledge).
- Enhanced when Latine/x students experience diverse interactions with peers.

Sense of belonging is connected to what a student thinks about “place, position, and purpose” in relation to a group and how that shapes how they feel. They make meaning of experiences. (Strayhorn, 2018).

PROMISING PRACTICES FOR SENSE OF BELONGING AND RETENTION IN STEM

- A strong sense of belonging validates students' multiple identities.
- Engage families, include culturally relevant teaching, and early exposure to STEM possibilities.
- Cultivate spaces to share experiences and build platforms for advocacy.
- Offer models and mentoring.
- Financial support is key!
- Offer membership and participation in internships and regional and national organizations focusing on diversity in STEM and specific disciplinary fields.

*We must attend to both STEM **culture and institutional climate** to cultivate more inclusive learning environments and increase diversity (Griffin, 2018 para 2)*

MEASURING SENSE OF BELONGING

Student Sense of Belonging in CUREs

Hanauer, D. I., Graham, M. J., & Hatfull, G. F. (2016). A measure of college student persistence in the sciences (PITS). *CBE—Life Sciences Education*, 15(4), ar54. (cited 155 times)

Student Sense of Belonging STEM learning communities & Culturally Responsive Curriculum Development Institute

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of personality and social psychology*, 102(4), 700. (cited 1423 times)

Culturally Responsive Course-Based Undergraduate Research Experiences (CUREs)



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UArizona CUREs

Spring 2021 - Spring 2024

74

Faculty, Staff,
Grad Students,
& Post Docs,
Participated

27

Courses
Redesigned

2043

Students
Served

46

CURE
Offerings

<https://ur.arizona.edu/cure-training-institute>

College of Agriculture, Life, and Environmental Sciences (CALES)

College of Applied Science and Technology (CAST)

College of Education (COEd)

College of Fine Arts (COFA)

College of Humanities (COH)

College of Science (COS)

College of Social and Behavioral Sciences (SBS)

W.A. Franke Honors College (HNRS)

The CURE Training Institute has been offered annually from 2020 – 2024 at UArizona. Dr. Sara Brownell from ASU is the instructor for the UArizona CURE Training Institute.

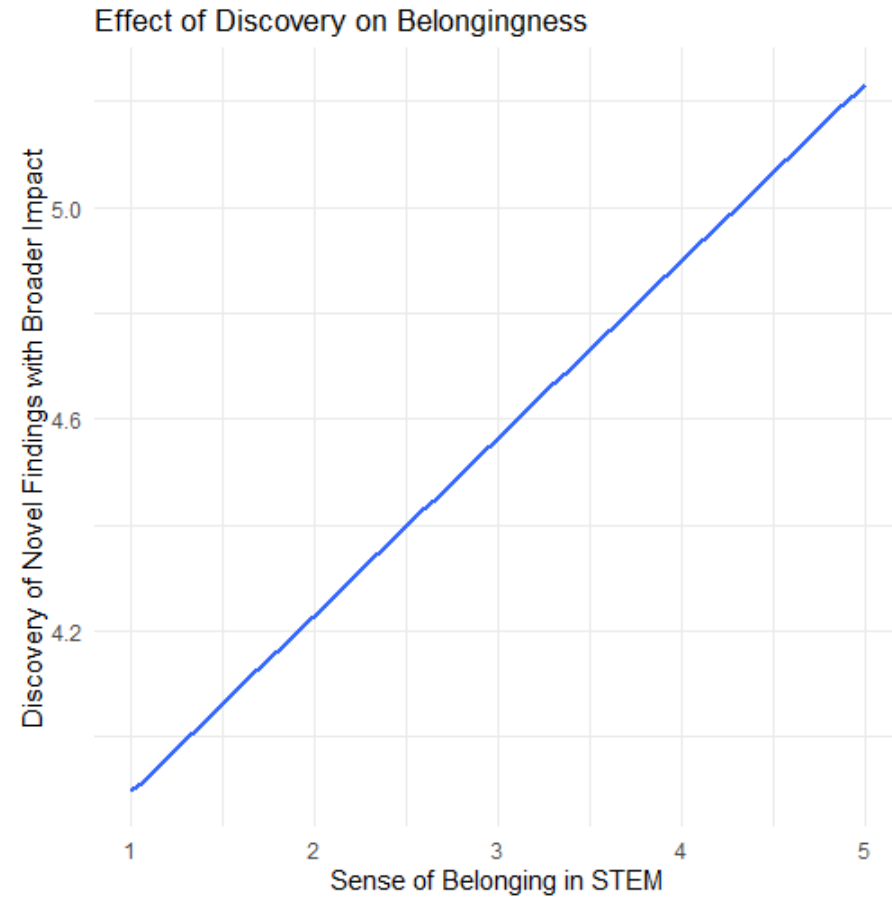
The Institute has been funded by a UArizona Provost Investment Grant, Arizona TRIF, and the U.S. Department of Education Hispanic Serving Institutions STEM and Articulation Program, Title III, Part F for Project CREAR.

Culturally Responsive Practices in the Biology II CURE Lab

Instructor: Ryan Ruboyianes

- Funds of knowledge
- Centering students' stories
- Reciprocity
- Valuing students' perspectives
- Affirming identities
- Co-create with community
- Increase human relatability
- Affirming in-class and on the syllabus
- Reflections
- Utilizing personal experiences encouraged to drive the design of the experiments
- Students co-constructing the experiments
- Students' input can affect course direction
- TAs trained to affirm team answers instead of penalizing a student for not knowing the answer or putting them on the spot

Effect of CUREs on Sense of Belonging

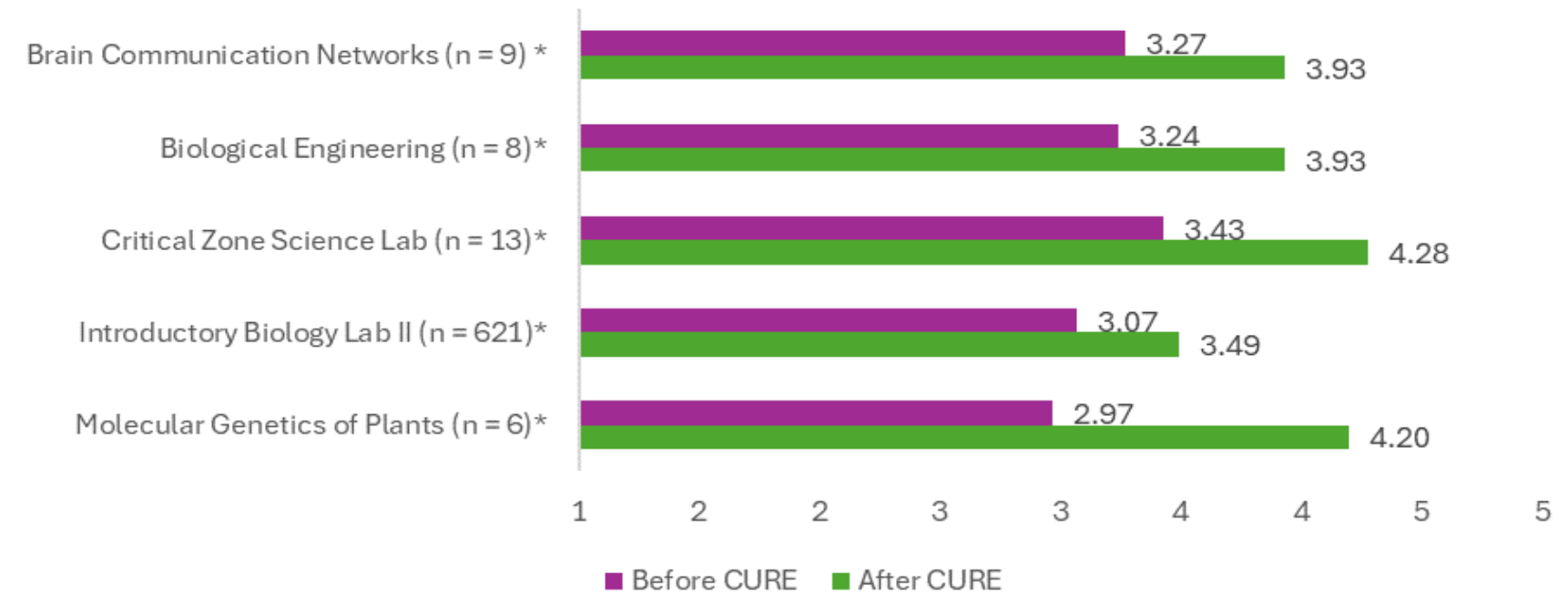


Effect of Discovery on Sense of Belonging in STEM

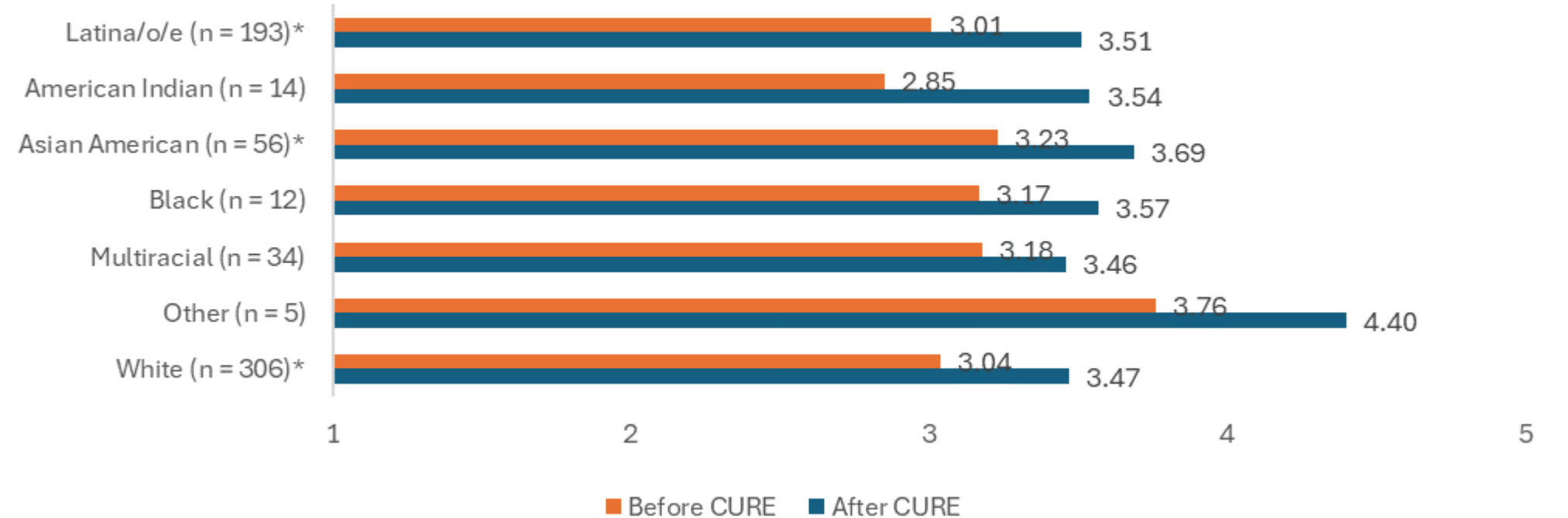
	Estimate	SE
(Intercept)	.08	.12
Discovery/Broader Impact	.23***	.02
Sense of Belonging before course	.76***	.02

Note. Multiple R²= 0.68, Adjusted R²= 0.68; p-value: < 2.2e-16

Change in Belonging by CURE



Change in Belonging by Race/Ethnicity



Culturally Responsive Curriculum Development Institute (CRCDI)



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Culturally Responsive Curriculum Development Institute

136

Faculty
Participated

56,100

Students
Served

140

Courses
Redesigned



The CRCDI is a week-long, summer immersion focused on coaching faculty and instructors towards implementation of culturally responsive practices and pedagogy into existing courses of all modalities, including distance and online learning environments.

The CRCDI is partially supported through UArizona's Project CREAR. Project CREAR is 94.1% funded through the U.S. Department of Education Hispanic Serving Institutions STEM and Articulation Program, Title III, Part F, for the amount of \$4,989,496.00 across a five-year award period and 5.9% funded through the University of Arizona for the amount of \$313,302 across a five-year period.

The CRCDI is partially supported through UArizona's Project LISTO (NSF award #2311013).

Culturally Responsive Curriculum Development Institute

Years 1 -3 Progress

31
STEM Faculty

STEM Gateway Courses	# students served by each course FA22-SP24
CHEM151 - General Chemistry Lecture I	1576
CHEM152 - General Chemistry Lecture II	1017
CHEM197B - General Chemistry Chemical Thinking Supplemental Instruction	64
CHEM197C - General Chemistry Lecture II: Chemical Thinking Supplemental	50
CSC110	715
ECOL182R - Biology II Lecture	1761
ECOL182L - Biology II Lab	2340
MATH112	626
MCB181R - Intro to Biology I Lecture	1578



Target Number of Students Reached:
1,000

Estimated Number of Students Reached
(gateway+non-gateway courses):
12,350+

9,727 total students FA22-SP24



Culturally Responsive Curriculum Development

Institute STEM courses, not identified as Gateway Courses



Target Number of Students Reached:
1,000

Estimated Number of Students Reached
(gateway+non-gateway courses):
12,350+

	# students served by each course FA22-SP24		# students served by each course FA22-SP24
AED295C	96	MATH119A	188
BIOC463A	174	MATH196L	32
CSC252	272	MCB325	136
CSC345	270	NURS471	220
DATA467	59	NURS478/9	148
ECOL407	10	NURS731	9
ESOC301	27	PSY150A1	429
ESOC330	22	PSY383	156
HDFS377	114	SLHS574	55
HPS178	212		

2,629 total students FA22-SP24



Culturally Responsive Practices in STEM Courses

Incorporating Local Knowledge and Local Examples

Connecting Course Material to Real World and Student Experiences

Enacting Pedagogies of Care

- * Being understanding of students' needs and situations
- * Learning students' names
- * Creating 1 minute introduction videos – bringing in an asset lens and asking students to do the same.

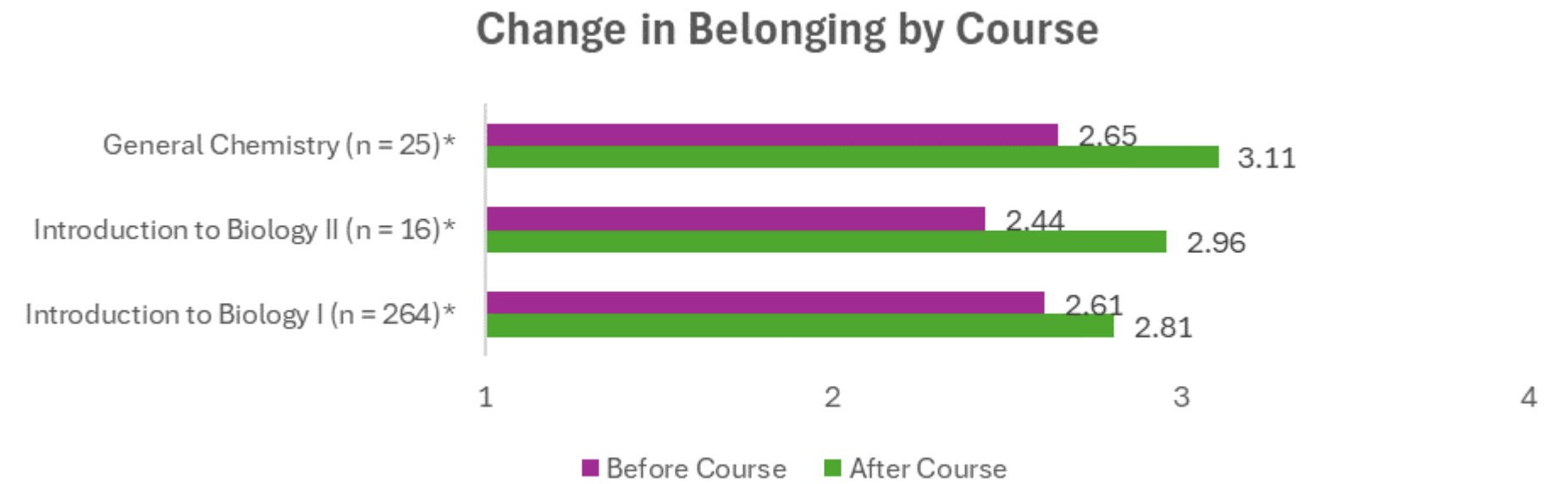
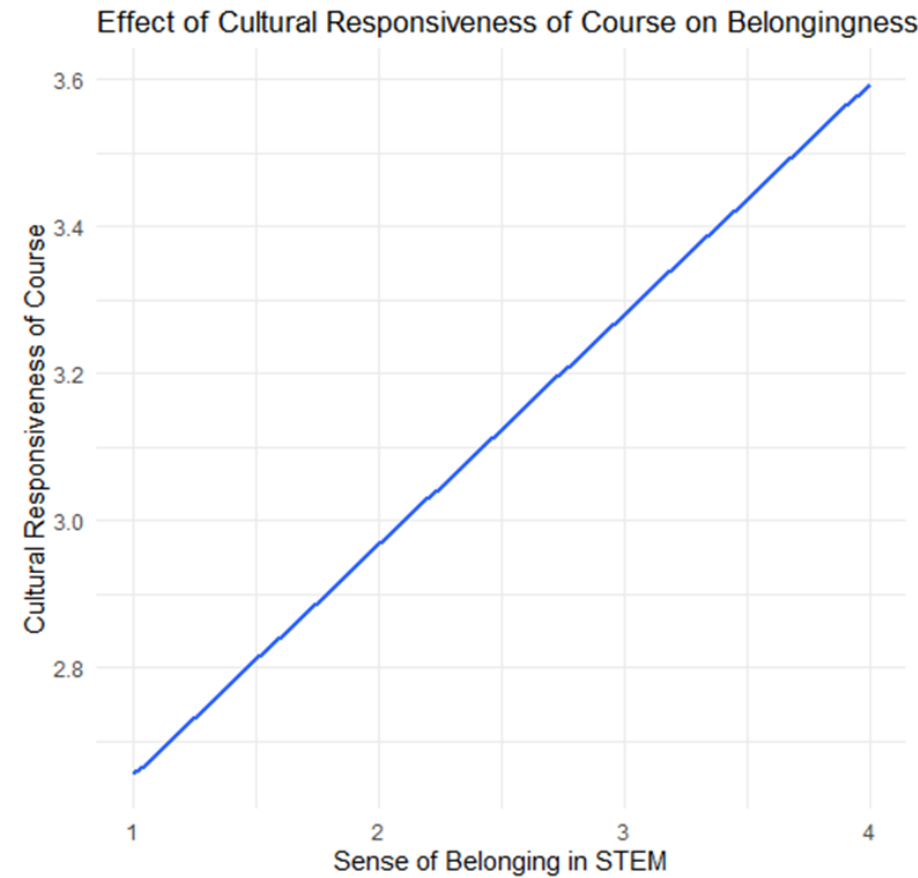
Leveraging Learning / Teaching Teams to help develop community with the class

- * Podcast: "For Students by the Students"
- * Graduate school pathways

Incorporating opportunities for "Exam Reflections" and "Golden Nuggets"



Effect of Culturally Responsiveness on Sense of Belonging

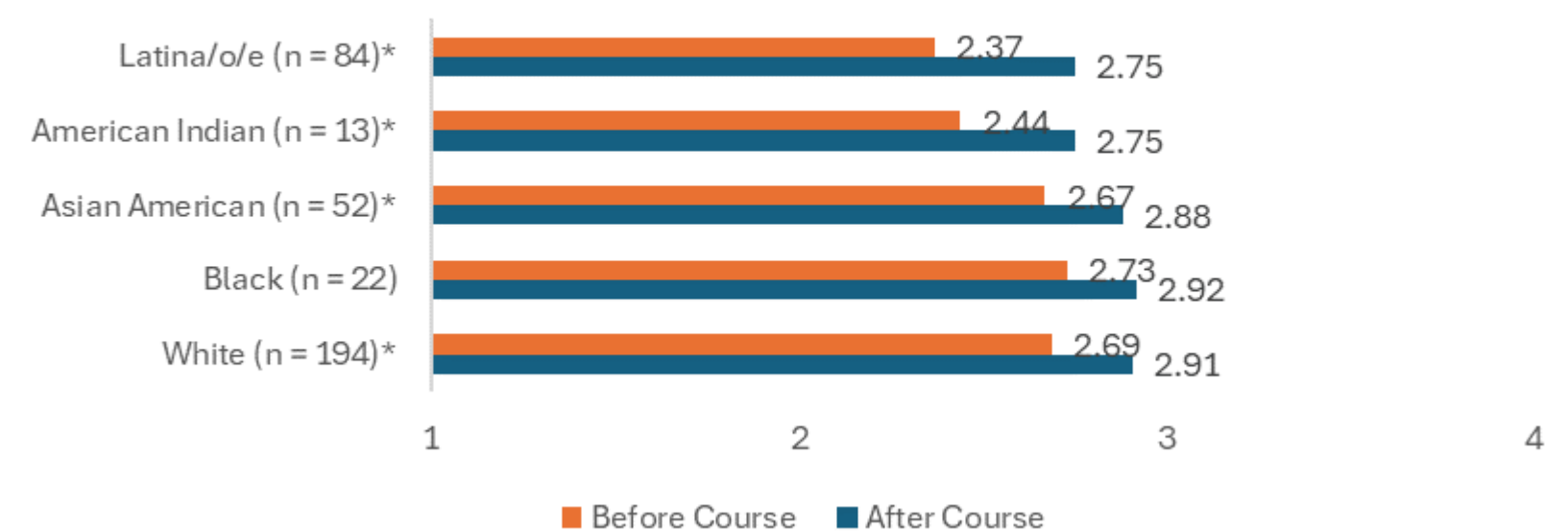


Effect of Cultural Responsiveness of Course on Sense of Belonging in STEM

	Estimate	SE
(Intercept)	1.05***	.19
Perceived Cultural Responsiveness	.22***	.05
Sense of Belonging before course	.42***	.04

Note. Multiple R²= 0.34, Adjusted R²= 0.33; p-value: < 2.2e-16

Change in Sense of Belonging by Race/Ethnicity



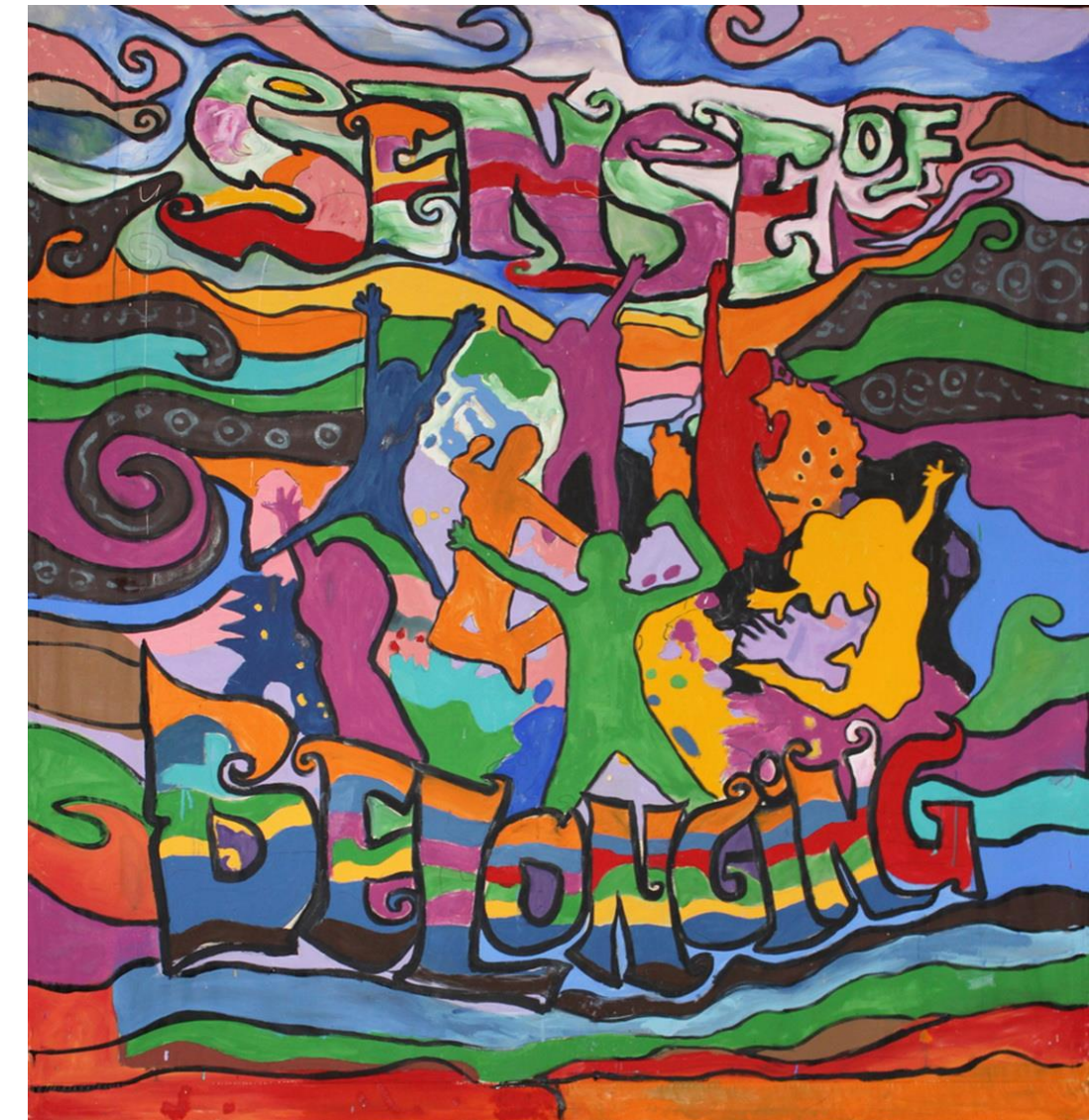
CRCDI & Individual Faculty Interviews (Lee & Kiyama, 2024)

Qualitative Case Study Methodology

- Pre / Post CRCDI surveys
- One year post survey
- Pre / post (re)designed syllabi
- Course observations
- **Individual Interviews with 25 participants**

*And I actually got the opportunity to do it with three, three other people that teach intro biology, which was another reason I chose to come to this institution, because I was really excited to be part of a team that, you know, is really student centered and thinking about how to essentially just make biology more approachable and accessible to students, which I think is at the center of these pedagogies. And it was just a really great experience in that it was nice that the Institute **brought together a community of faculty to share ideas, interest, be in solidarity a little bit, you know, and so it was very, my colleagues and I talked about this all the time, it was like self-care, and work at the same time.***

*And then there was the track of just like informal building community being able to feel like you belong. Find people who would affirm and understand your work, you know, and some of those things are, you know, hard to quantify, like, there's just the feeling of being in the space you know, **of seeing yourself reflected in the curriculum, in language, and examples in the speakers.***



Culturally Responsive Curriculum Development Institute

May 19 – 23, 2025
Tucson, AZ



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STEM Learning Communities

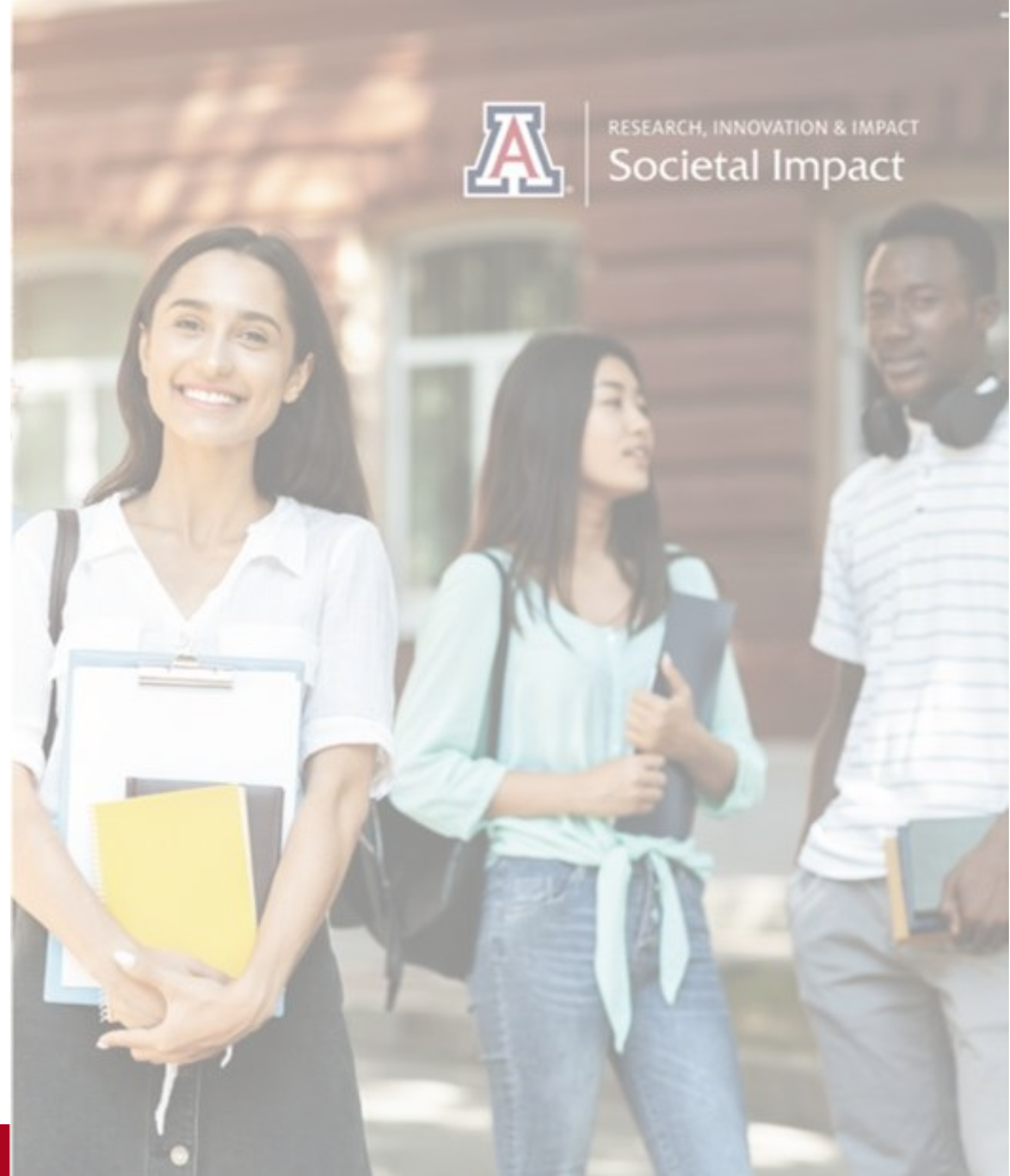


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Designing STEM Learning Communities through Culturally Responsive Practices:

- Student-centered in all Stages of Engagement
- On-boarding & Training
- Developing Institutional Partnerships



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STEM Learning Communities

> 500

Students
Served

29

Cohorts

8

Learning
Community
Configurations

The CREAR STEM Learning Communities offer a supportive and empowering environment that fosters inclusivity, belonging, and a shared passion for STEM disciplines. Students who join our communities can expect:

- A 1-unit first-year course, Success in STEM, led by a trained Peer Educator, offering them the chance to engage with peers with similar interests or career goals.
- A STEM course (like math or chemistry) aligned with their math placement level and program of study.
- Access to Student Success Specialists who provide holistic support and assistance in overcoming barriers to success.



CENTERING ASSET-BASED & CULTURALLY AFFIRMING APPROACHES

- **Outreach & Recruitment**
 - Early peer-to-peer connection through call campaign
 - High school campus visits
 - Bilingual transposition of program information
- **Acknowledging and Serving the “whole” student**
 - Reframing conversations about math
 - Consideration of familial responsibilities
 - Consideration for commuter students
 - Providing options, meeting students where they are
- **STEM Academic Engagement**
 - Empowering students to see themselves doing the work
 - Connecting students with one another and making connections within STEM together
 - *Scalable* practices removing barriers, increasing sense of belonging, and developing STEM Identity



IN ALL STAGES OF STUDENT ENGAGEMENT

Culturally Responsive Student Leadership Training

- **Validating student leaders' identities**
 - Intentional exploration of social identity within the context of student leadership
 - Affirming student leaders' importance within the greater STEM Learning Communities system
- **Centering student leaders' experiences**
 - Regularly building in space for reflection and discussion to contextualize training content in perceived role
 - Affirmed that returner feedback and experiences were valid and actively informed training facilitation and content
- **Building a culture and community of student leadership across teams**



Developing Institutional Partnerships

DEFINING KEY CAMPUS PARTNERS

Colleges & Academic Departments

Academic Advising Teams

University Operational, Technological, & Information Systems

Student Support Services/Depts./Programs

ESTABLISHING COLLABORATIVE RELATIONSHIPS

Understand existing systems/processes in place

Express gratitude

Find common ground

Negotiate options

Determine openness to try

CONTINUOUS IMPROVEMENT

What worked?

Is it sustainable?

What was the *student* experience?

What needs to change?

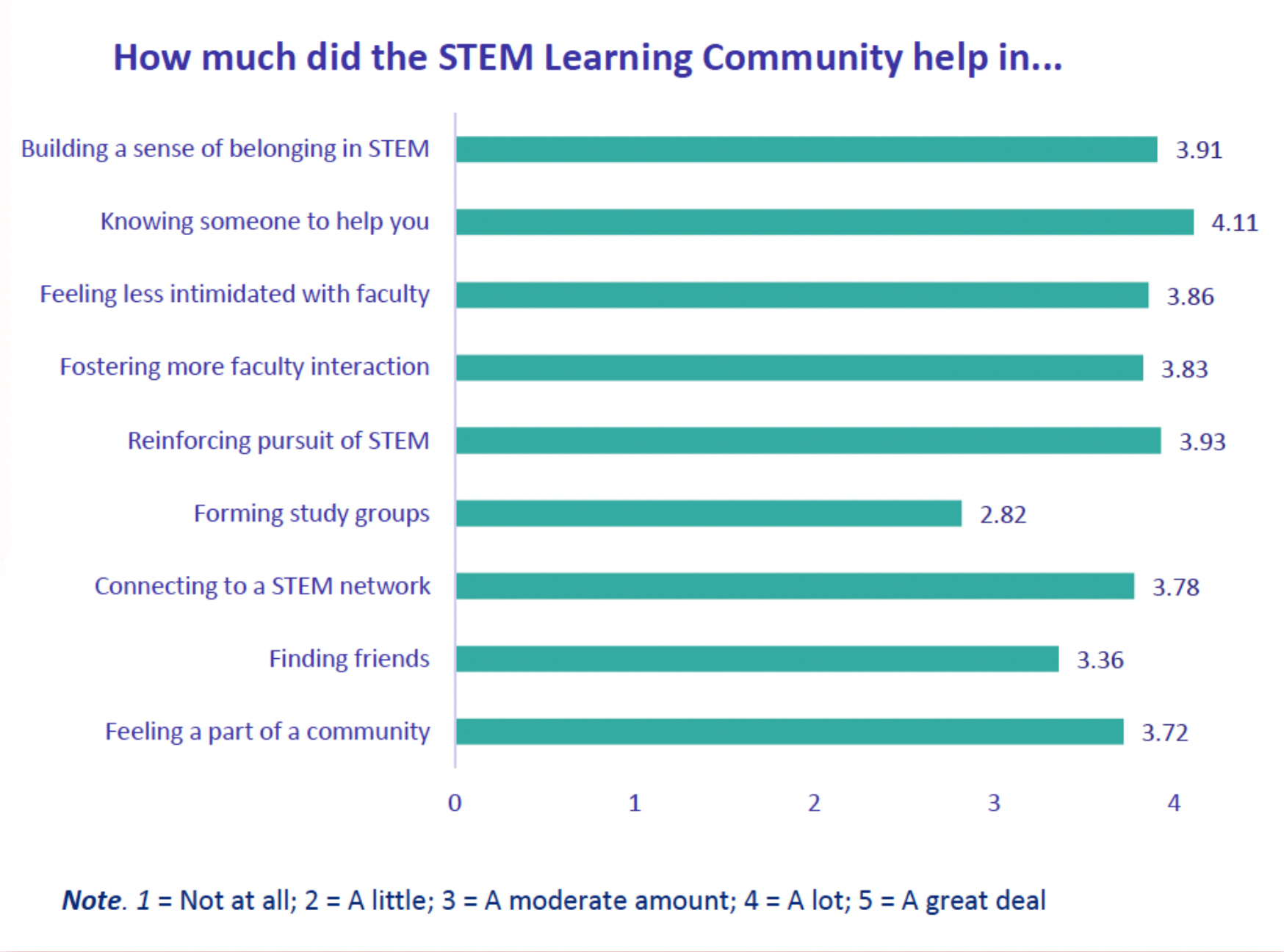
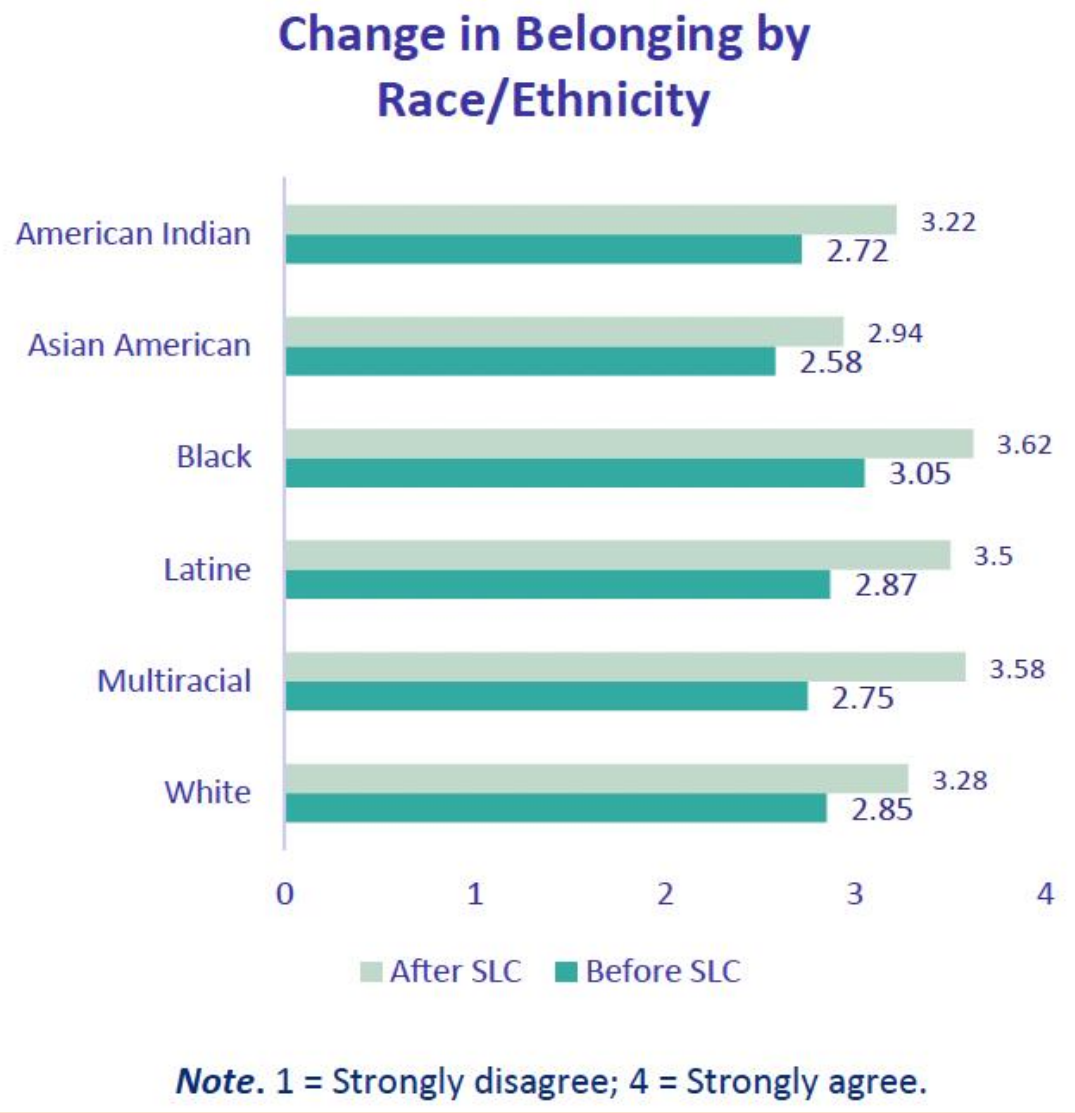
Implement changes

Fall 2023 Post-Survey Results: *Peer Educators*



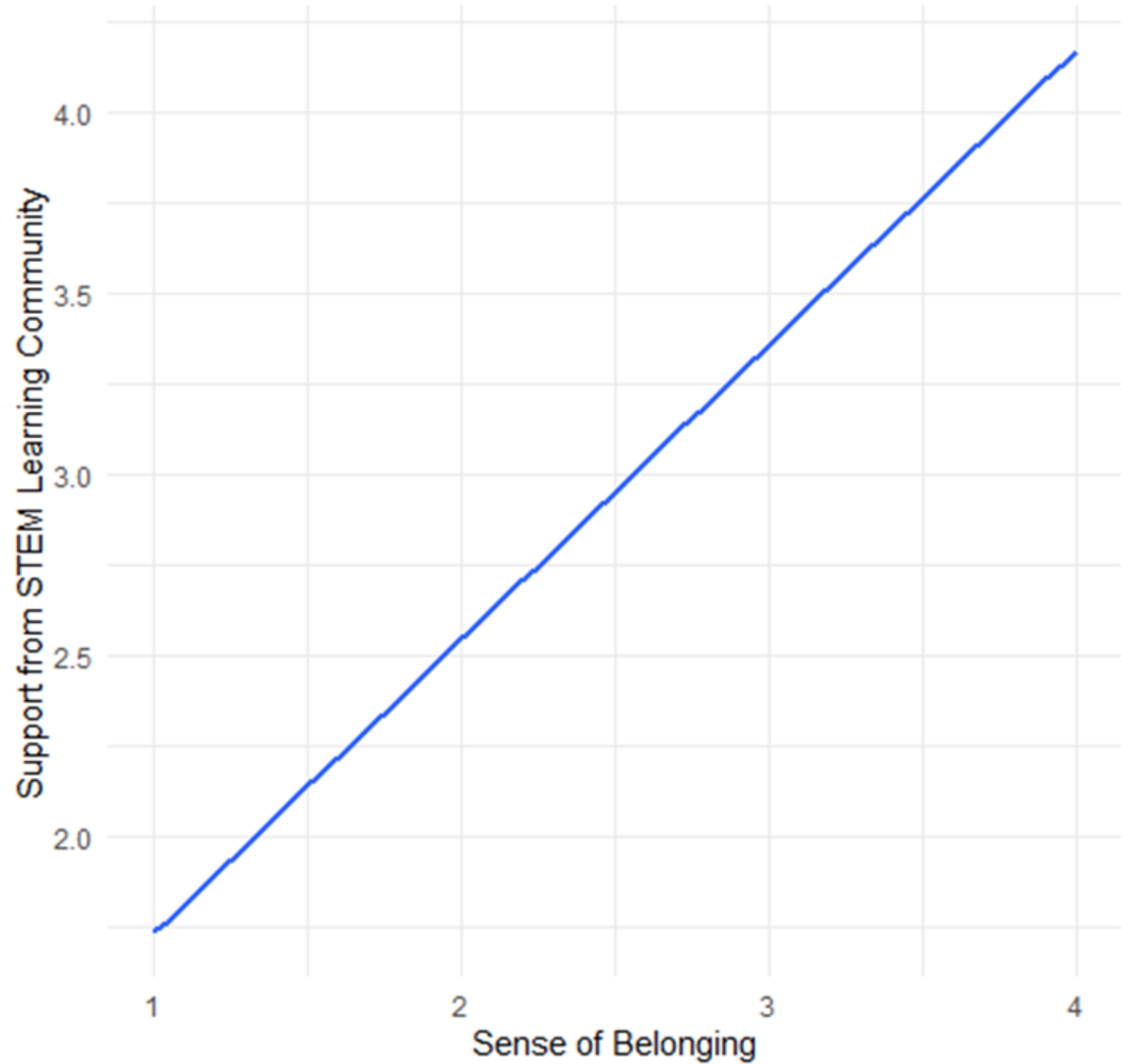
Fall 2023 Post-Survey Results: *STEM Learning Communities*

Significantly increased in identifying as a scientist
2.98 out of 4



Effect of Participation in SLC on Sense of Belonging

Effect of Perceived Support on Belongingness

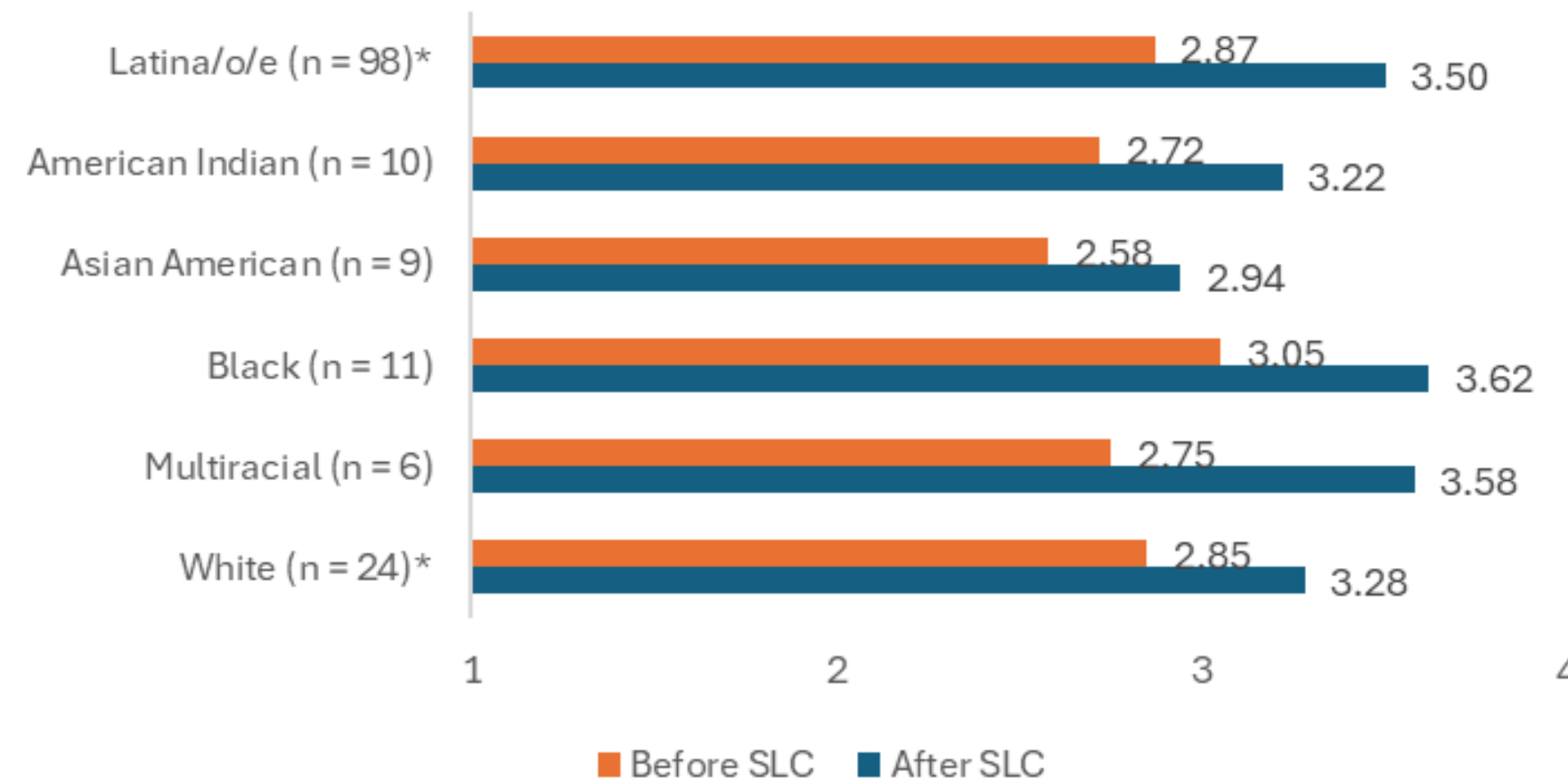


Effect of Perceived Support on Sense of Belonging in STEM

	Estimate	SE
(Intercept)	1.29***	.18
Perceived Support from SLC	.39***	.04
Sense of Belonging before SLC	.25***	.04

Note. Multiple R²= 0.48, Adjusted R²= 0.47; p-value: < 2.2e-16

Change in Belonging by Race/Ethnicity



Acknowledgements

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Project CREAR Project Manager, Office of Societal Impact

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Associate Research Professor
Director, Center for Educational Assessment, Research, & Evaluation (CEARE), Dept. of Educational Psychology

Dr. Rebecca Friesen

Research Scientist, CEARE, Dept. of Educational Psychology



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Questions?



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Measuring Student Sense of Belonging in CUREs

Hanauer, D. I., Graham, M. J., & Hatfull, G. F. (2016). A measure of college student persistence in the sciences (PITS). *CBE—Life Sciences Education, 15*(4), ar54. (cited 155 times)

Range: 1 = strongly disagree to 5 = strongly agree.

- 1) I have a strong sense of belonging to the community of scientists
- 2) I derive great personal satisfaction from working on a team that is doing important research
- 3) I have come to think of myself as a scientist
- 4) I feel like I belong in the field of science
- 5) The daily work of a scientist is appealing to me.

Measuring Sense of Belonging in STEM LCs and CRCDI Courses

Good, C., Rattan, A., & Dweck, C. S. (2012). Why do women opt out? Sense of belonging and women's representation in mathematics. *Journal of personality and social psychology*, 102(4), 700. (cited 1423 times)

Range: 1 = strongly disagree to 4 = strongly agree.

- 1) I feel that I belong to the STEM community
- 2) I consider myself a member of the STEM world
- 3) I feel like I am a part of the STEM community
- 4) I feel a connection with the STEM community.

THANK YOU



Judy Marquez Kiyama

Professor, Center for the Study of Higher Education;
Dept of Educational Policy Studies & Practice; Univer...



Kimberly Sierra-Cajas

Director, Undergraduate Research
& Inquiry



Christopher Oka, M.Ed.

Manager for Curriculum & Training with the STEM
Learning Center at The University of Arizona | Ed...



Andrea Maria Palacio

Higher Education & Student Services Professional



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