



“STEM Teacher Persistence, Retention, and Teaching Practices Related to Research Experiences: Preliminary Findings Connecting Student Development to Broader Impacts Opportunities”

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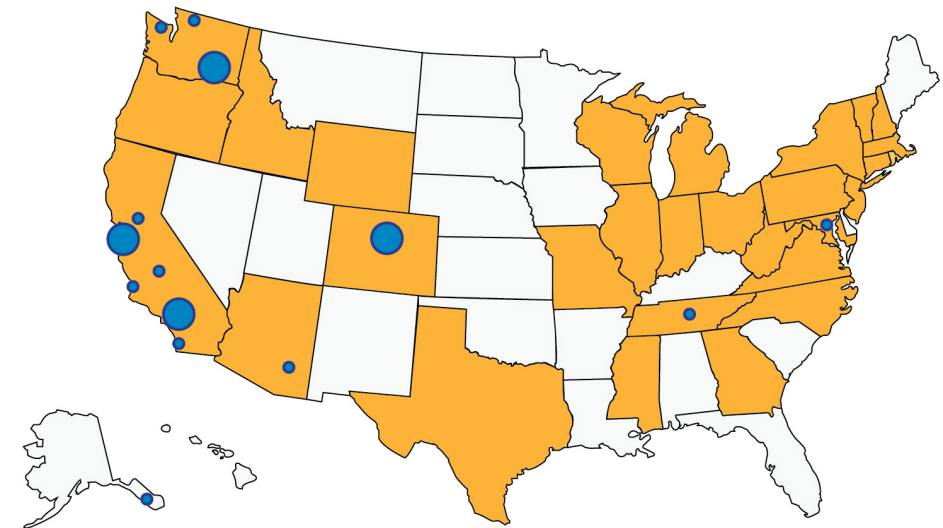


Study Overview

- NSF Robert Noyce Teacher Scholarship Program
- STEM Teacher and Researcher Program (STAR)
 - California Polytechnic State University in San Luis Obispo.
- Authentic **research opportunities** for prospective K-12 science and mathematics teachers within their pre-service education program is a relatively recent STEM education element.
- This Collaborative Track 4 Noyce Research investigates how this approach impacts teacher effectiveness (practices), persistence, and retention.



- Since 2007, the STAR Program has provided 640 summer research experiences to 471 STAR Fellows, including 244 Noyce Scholars from 29 states.
- National research laboratories: e.g. NASA, NOAA, NSF, DOE, DOD, USGS.



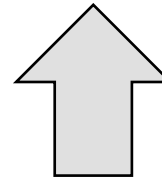
- STAR Fellow campus state
- Multiple research sites
- Individual research site

Theoretical framework: 3rd Gen. Activity Theory

Tools: Lab Experience, STAR Workshops, Research Poster

Outcomes:
 Teacher Retention
 Teacher Persistence
 Classroom Practices
 Student Achievement

Tools: Curricula, Pedagogy



Shared Object:
 Teacher/
 Researcher
 Identity

**STAR
 Activity
 System**

**Teacher
 Activity
 System**

Subject:
 Preservice/Early
 Career Teacher

Subject:
 In-Service
 Teacher

Rules: Attendance,
 Lab Protocols,
 Deliverables

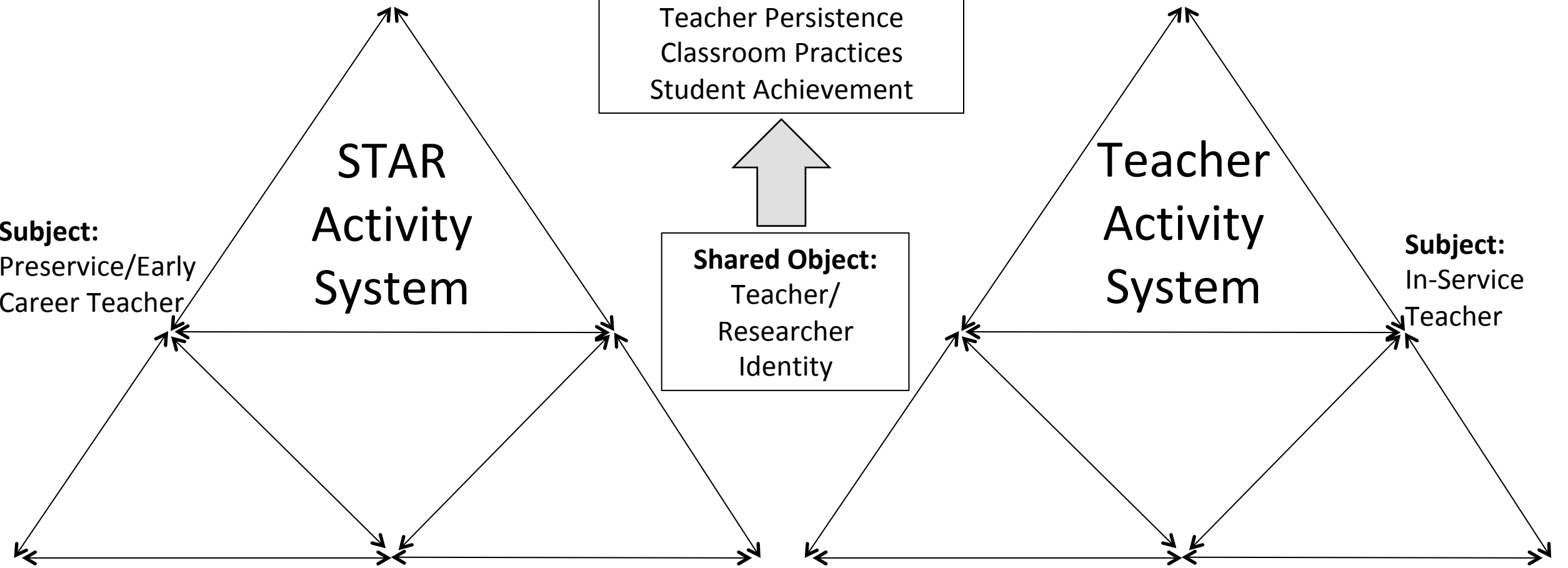
Community:
 STAR Program & Cohort
 National Laboratory

Division of Labor:
 STAR Program Director/
 Coordinators; Mentors

Rules: School/District
 Policies

Community:
 District, School,
 Classroom

Division of Labor:
 District Admin, School
 Admin, Teachers, Students





Research Questions



1. Are STAR Fellows (Noyce or non-Noyce) more likely to *persist* and/or be *retained* in high-need settings? If so, why?
2. Compared with other teachers at their schools and in their districts, what teaching practices emerge from STAR Fellows (Noyce or non-Noyce) engaging students in STEM learning?



Data Sources

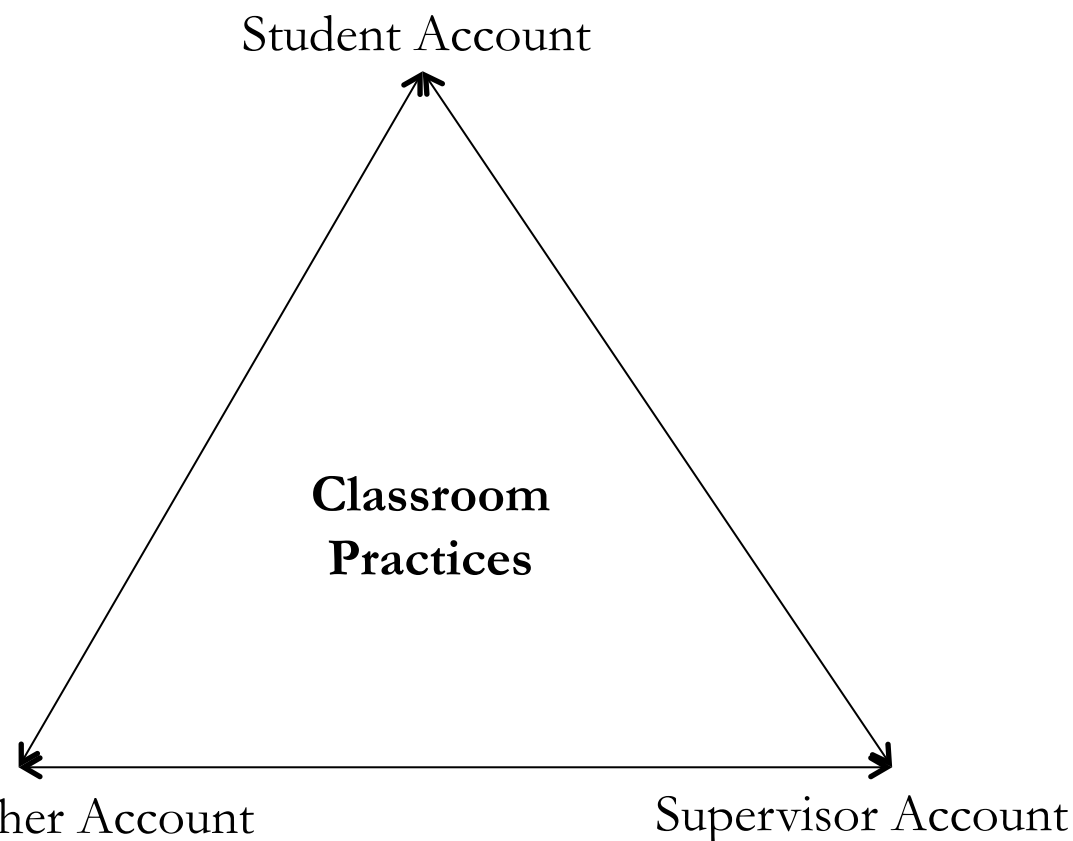
Evaluating teacher practices, persistence, and retention.

AY 2017-18: STAR Survey and Extant California Data

- Survey of 2010-15 STAR Alumni and Applicants
- CSU Credential Exit Evaluation
- CSU Teacher Evaluation of First-Year Teachers
- CSU Supervisor Evaluation of First-Year Teachers
- CA Department of Education Teacher Employment Data

AY 2018-19: Data from Case Study Institutions and Districts

- Teacher Survey of STAR alumni and comparison teachers (on-going)
 - K-12 Students Survey of STAR alumni and comparison teachers (on-going)
 - NGSS Assessment Scores by class from STAR alumni and comparison teachers from case study districts (on-going)
- Phone Interviews
 - STAR Alumni from case study districts (n = 7)
 - Comparison Teachers from case study districts (n = 8)
 - Principals from case study districts (n = 4)





Preliminary Findings: STAR teacher practices



Theme 1) Design inquiry labs

Theme 2) Modeling of researcher “mindset”/experiences

Theme 3) Real world contextualization and validation



Preliminary Findings: STAR teacher practices

Theme 1) Design inquiry labs

- Autonomy & agency
- Collaborative
- Connected to “real-world”

J: I don't do any, again, cookie cutter types of labs, where it's just, you know, verify “acceleration due to gravity as 9.8 m/sec^2 ” type of thing. I try to get them to dig a little deeper and not follow somewhat of a guideline.

They have to really think through with their teammates and their group members how they're going to conduct an experiment; what is their control; what are they going to measure; how are they going to interpret the data; what trends, what things are they looking for? So that's just kinda how I formulate the labs. I don't give 'em a handout that tells 'em the steps that they need to do.

I: Do you think that is a result of your STAR experience?

J: I think it had a great impact on it because had my mentor there said, or had the scientists said: “Hey, I want you to do this, this, this, this, and this,” I may not have known why I was doing that. And so I didn't want my students to do that. I wanted them to experience science, not just see how well they could follow steps.



Preliminary Findings: STAR teacher practices



Theme 2) Modeling of researcher “mindset”/experiences

- Perseverance, curiosity/growth, active participation

I: Do you attribute any of what you do in your classroom on a daily basis to your STAR experience?

Judy: Yeah, I do. And I think some of that is just a mindset I have. Like, I'm not worried about students making mistakes. I want them to... I really try to encourage them to be pushed out of their comfort zone. And I think, again the one thing that I saw in that STAR experience and that I experienced myself was that it's okay to be wrong; you should just know why you were wrong.

And if you can't figure out why you were wrong, then that's a more interesting question, so like that everything is leading to some learning and to some stuff for us. So I guess that's the mindset that I definitely carry over, that whatever they're doing is pushing their knowledge forward, so... my first year that I taught, I was teaching chemistry, and I actually had a direct correlation to what we were doing in my research experience.

So I had my chemistry students use planetary spectra to look for what the light looks like coming off a planet and use that to try to identify what molecules might be in the atmosphere and whether or not that might be a sign of life, which is exactly what the research were doing at JPL [see Theme 3] see, so that felt extremely authentic, and I felt like I had quite a bit of street cred, like do your thing, you know? [see Theme 3] Like, “We don't know no NASA.” But in physics, so I did kind of the same project, but I ended up having the students form their own research groups, so they came up with their own proposals, and I based their proposal structures on NSF requirements, so it was pretty intense [see Theme 1]. They had like blind peer reviews, and like we had ... it took quite awhile, and it was really intensive, but the kids were totally into it, and the result was that they ultimately made ... designed their experiment, formed their own research groups, and then did their experiments. So that was really awesome and rewarding and grueling.



Preliminary Findings: STAR teacher practices



Theme 3) Real world contextualization/validation

- Perspective, independence, confidence & agency

I: Do you feel that your STAR experience had an impact on the way you teach your classes?

Gary: I think the research side of my STAR experience was what allowed me to kind of make my microbiology class rigorous, where I can not only have students do labs that are meaningful and teach them valuable lab skills, but also important things about the subject area.

I think also it allows me to kind of talk with them about kind of the history side of doing research in the field in that study area. I'd say it allows me to kind of draw on knowledge of how things are done in the research area. So, like how we define labs and how we go about that and then also trying to teach, like lab safety, not just from like a teacher standpoint, but lab safety from like an industry standpoint. So understanding the why behind lab safety from that perspective I think could be one thing. But I think it's also allowed me to make labs feel kind of more real world, where I can talk about, like... "These skills if you want to go into this industry, it's expected that you know how to do this, to go in and actually be able to perform that." So it's not a job where you walk in and they teach you everything you need to know, like you need to have some base skills. And that's kind of what I'm also teaching them through that as well.

I would probably have to say [another way is the] kind of the independence and the ... like, I had to find resources and solutions myself if I ran into a problem. So I think maybe giving me the confidence to say, "Hey, I would be able to figure this all out," and then giving them that support so that they can figure out how to do research on their own, how to perform labs on their own, how to find solutions to their questions on their own.



Connecting to Broader Impacts

1. Informs how **teacher effectiveness (practices), retention, and persistence** are impacted by enrichment of the Noyce Scholar experience through summer research provided by the STAR Program.
2. Informs **STEM education and educator development** by illustrating impacts of providing research experiences for pre-service teachers.
3. Informs **research partnerships** involving academia, industry, and federal agencies.
4. Informs the extent to which **teacher-researchers effectively engage and prepare their students**, including women and minoritized groups in STEM.
5. Has strong potential to broadly and significantly contribute to both **policy and practice** associated with STEM teacher preparation.

Thank you!...Questions?

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