

# UC Berkeley

## Berkeley Review of Education

### Title

The Role of a Summer Field Experience in Fostering STEM Students' Socioemotional Perceptions and Social Justice Awareness as Preparation for a Science Teaching Career

### Permalink

<https://escholarship.org/uc/item/7kg400hd>

### Journal

Berkeley Review of Education, 9(2)

### Authors

Liu, Amy  
Toma, Shannon  
Levis-Fitzgerald, Marc  
et al.

### Publication Date

2020

### DOI

10.5070/B89244648

Peer reviewed

# The Role of a Summer Field Experience in Fostering STEM Undergraduates' Socioemotional Perceptions and Social Justice Awareness as Preparation for a STEM Teaching Career

Amy Liu,<sup>1</sup> Shannon Toma, Marc Levis-Fitzgerald,  
and Arlene A. Russell

University of California, Los Angeles

## Abstract

*This study aimed to better understand the role that an undergraduate teacher exploration program for STEM majors played in STEM teacher education and recruitment. Utilizing journal data from 126 undergraduate students engaged in an intensive and immersive four-day internship that took place in Summer 2015 and Summer 2016, this study examined how the program's field experience developed students' socioemotional perceptions and social justice awareness. The field experiences took place at high-need middle and high schools in Los Angeles. With respect to socioemotional perceptions, findings show that STEM undergraduates who participated in the internship demonstrated insight about relating one-on-one with students, being caring and compassionate, establishing positive relationships, accommodating varying capabilities, and witnessing students and teachers supporting each other. Regarding social justice, participants expressed experiential understanding related to equity of learning opportunities, asset-based interpretive frames, recognition of privilege, and advocacy and activism. The field experiences allowed the STEM undergraduates to more deeply appreciate the importance of connecting with students, developing positive and constructive relationships with them, and reflecting on educational inequities confronting schools and students—a valuable foundation of teacher preparation for those who may choose to pursue a formal social justice-oriented teacher education program.*

**Keywords:** field experiences, teacher education preparation, social justice, socioemotional learning, recruitment and retention, science teacher education

Contemporary public skepticism regarding topics where there is robust scientific consensus—such as evolution, vaccinations, and climate change—call into question the health of our nation's scientific literacy (Beck, 2015). Lest we become a nation of

---

<sup>1</sup> Correspondence concerning this article should be addressed to Amy Liu, Center for Educational Assessment, University of California, Los Angeles, 190 Powell Library, Box 951515, Los Angeles, CA 90095-1515. E-mail: [amy.liu@ucla.edu](mailto:amy.liu@ucla.edu)

scientific disbelievers, the urgency for greater science education and literacy across all educational levels is high. Rather than merely relying on experts to counter denials of science, a goal of science educators is to advocate for the cultural and social values of science itself to develop our national science literacy and appreciation for scientific inquiry (DeBoer, 2000). Scientists have noted the importance of creating a “culture of science” and generating “excitement and passion about the scientific enterprise” (Hyde-Keller, 2017, para. 12).

At the front lines of any educational imperative are our nation’s teachers. We need a strong workforce prepared to teach in the fields of science, technology, engineering, and mathematics (STEM). Yet data from an American College Testing (ACT; 2015) report reveal that interest in becoming science and math educators is miniscule and declining:

Five-year trends indicate that of the more than 1.9 million students who took the ACT in 2015, fewer than 88,000 students indicated an interest in education majors or professions. In the areas of math and science education, the numbers are even more concerning, with fewer than 3,700 indicating an interest in these subjects. (p. 3)

In California, the supply of new K-12 teachers is at a 12-year low despite increasing demand; from 2001 to 2014, there was a 76% decline in enrollment in California’s teacher preparation programs, and the teacher shortage is most acute in math, science, and special education (Darling-Hammond, Furger, Shields, & Sutchter, 2016). This veritable “STEM teacher drought” (Wolf, 2015, p. 1) is contributing to insufficient STEM learning opportunities for tens of thousands of the state’s youth.

Furthermore, research related to teacher recruitment and retention has suggested that science and math teachers are more likely to leave teaching within the first few years (Guarino, Santibañez, & Daley, 2006). Within a three-year period, Henke, Zahn, and Carroll (2001) found an attrition rate of 30% for first-year teachers who majored in STEM fields, compared to 14% for education majors. In a report about first-year science teachers, Bang, Kern, Luft, and Roehrig (2007) noted that school climate and lack of a supportive work environment were the main factors for leaving. Reports also indicate there are fewer science- and math-certified teachers at public high-need schools—defined herein as those in historically underserved communities with high-poverty enrollment—compared to low-poverty schools (National Science Board, 2016). For example, a 2016 National Science Board report indicated that 88% of mathematics teachers and 91% of science teachers in high-need schools were fully certified, whereas 95% of both mathematics and science teachers were fully certified in low-poverty schools.

The heightened need for strengthening the recruitment, preparation, and retention of K-12 science and math teachers has fostered alliances at the national, state, and institutional levels. In 2002, the National Science Foundation established the Robert Noyce Teacher Scholarship Program, which provides funding to higher education institutions to support STEM teacher recruitment. In an effort to increase the supply of science and math teachers at the state level, the University of California (UC) has been actively recruiting and preparing undergraduate math and science majors for potential careers as educators. In 2005, the UC system launched CalTeach, an academic and career

preparation program, at all its undergraduate campuses. The program provides courses and fieldwork experiences designed to improve the pipeline from undergraduate STEM studies to math and science teaching credentials (Newton, Jang, Nunes, & Stone, 2010). According to the UC CalTeach (2017) website, the impact has been significant:

Since its inception, more than 15,000 UC undergraduate students have explored careers in teaching math or science through CalTeach. Of these, roughly 2,000 CalTeach participants have gone on to receive single-subject math and science credentials, and more than 1,700 CalTeach alumni have pursued teaching in California's public schools. (para. 1)

An additional utility of the CalTeach program is the opportunity to use it as a lab environment for educational research. Potential topics of study include strategies for recruitment and retention, practices for effective math and science education, preparedness for teacher education programs and teaching, and improving attitudes toward teaching and public education (University of California Office of the President, 2017). The present study utilized data generated through a summer field experience internship coordinated by the University of California, Los Angeles (UCLA) CalTeach office to further our understanding of teacher exploration programs. In doing so, we aimed to better appreciate the importance of inspiring and preparing students to consider a career that advances our national science education and literacy.

### **STEM Teacher Preparation and Field Experiences**

Robust models of teacher preparation center on three intersecting bodies of knowledge: knowledge of subject matter, knowledge of teaching, and knowledge of learners and their development in social contexts (Darling-Hammond, 2006). In addition to finding that science and math teachers exit teaching at rates higher than teachers of other subjects (Guarino et al., 2006), researchers examining teacher education and teacher attrition suggest that science and math teachers have less pedagogical preparation than teachers in other fields. For example, Ingersoll, Merrill, and May (2014) used national data from the National Center for Education Statistics and found that although science and math teachers generally had more subject-content and graduate-level education than other teachers, they had much less preservice teaching experience. Despite being knowledgeable about subject content, science and math teachers had less knowledge about teaching and were less likely to have the kinds of preparation linked to greater teacher retention, such as field-based teaching practice, observations of classroom teaching, and feedback on their own teaching.

Field experiences, specifically field-based teaching practice, are important features of teacher preparation programs (Darling-Hammond, 2006; Wilson, Floden, & Ferrini-Mundy, 2001). Coherent, well-integrated field experiences are critical to developing teaching knowledge. In articulating the importance of clinical experience, Darling-Hammond (2006) noted that the best programs incorporate field time concurrent with coursework. She highlighted four aspects of effective field experiences: They should be (a) extensive throughout the length of the teacher education program, (b) intensively supervised, (c) with teachers who model expert practice, and (d) in classrooms that serve

diverse students. In Feiman-Nemser's (2001) secondary analysis of seven exemplary teacher education program case studies presented by Darling-Hammond and colleagues (Darling-Hammond, Koppich, & Merseth, 2000; Darling-Hammond, Macdonald, Snyder, Whitford, Ruscoe, & Fickel, 2000; Darling-Hammond, Zeichner, Miller, & Silvernail, 2000), she argued that preservice classroom experience plays a critical role in learning to teach. Field experiences provided teaching candidates with a continuum of opportunities to place their theoretical learning into practice as they moved from observation to limited participation to full responsibility. Feiman-Nemser (2001) further noted that well-structured field programs also promoted reflection and used a mix of reflective logs, dialogue journals, cohort-based seminars, and individual conferences. This allowed prospective teachers to learn from the experience as well as engage in thoughtful analysis of their own and others' practice—important factors in developing knowledge of teaching.

In establishing priorities for contemporary teacher preparation, teacher education researchers have called for teachers to gain deeper knowledge of educating diverse learners who reflect myriad language, cultural, and learning approaches (Darling-Hammond, 2006). Just as field experiences promote a theory-into-practice-based understanding of teaching, they also mediate the development of knowledge about learners in classroom contexts. Research examining the impact of teacher preparation and field experiences on responding to culturally diverse environments has been mixed, with some studies finding positive changes with respect to cultural diversity and others documenting negative outcomes (Hollins & Guzman, 2005; Sleeter 2008; Sleeter & Owuor, 2011). The bulk of this line of inquiry reflected the perspectives of white preservice teachers (Sleeter, 2008), and therefore the continued desire to discover best practices for teacher preparation on the dimensions of diversity and equity remains an important line of inquiry (Cochran-Smith et al., 2015). Nevertheless, Sleeter (2008) noted that field experiences that incorporated guided inquiry and extended reflection were more effective than those without these structured elements. In their review of the research, Sleeter and Owuor (2011) emphasized that “teachers’ abilities to establish caring relationships with students from historically marginalized backgrounds and to demonstrate firm beliefs that students can achieve academically is crucial” (p. 525).

Aligned with the aims of teacher preparation for diversity and equity is the belief in teacher preparation for social justice (Cochran-Smith, 2010; Mills & Ballantyne, 2016; Wiedeman, 2002). As Wiedeman (2002) explained, within the context of teacher preparation, “social justice means examining why and how schools are unjust for some students” (p. 200). She further elaborated that “the focus is on assisting educators in critiquing the larger socio-cultural, political dimensions of teaching and schooling” (p. 200). Reflective tasks, such as journals and team debriefings employed during field experiences, have beneficial impacts on preservice teachers’ beliefs and attitudes toward social justice (Mills & Ballantyne, 2016). A concurrent perspective that contributes to an understanding of social justice and equity is an ethic of care, which is driven by interpersonal relationships (Noddings, 2012). By focusing on care, teachers endeavor to best support students by understanding their social and emotional learning (SEL) needs (Schonert-Reichl, Kitil, & Hanson-Peterson, 2017). Research examining the integration of SEL into teacher preparation programs is an emerging line of inquiry (Schonert-

Reichl, 2019), one that we argue should also incorporate considerations of social justice given that any SEL preparation of teachers should be done so with respect to a diverse spectrum of learners and schooling contexts and with recognition of ongoing structural inequities in education.

For prospective science and math educators, it would appear that both subject-content knowledge and pedagogical knowledge are crucial foundations to build during teacher preparation. The contemporary expectations for teachers to be well-versed about diverse learners and advocates for social justice in classroom contexts calls for continued research into programs and practices that can foster development in these areas. Knowing that well-structured and tightly integrated field experiences that allow for practice-based learning and reflective teaching can be integral to teacher preparation, we now turn to a review of outcomes associated with the field experiences of STEM undergraduates.

### **STEM Undergraduates' Field Experiences**

Studies examining the teaching field experiences of STEM undergraduates revealed positive benefits, including how these experiences shape attitudes about science and math teaching careers and the teaching profession generally (Bischoff, French, & Schaumlöffel, 2014; Borgerding, 2015; Fletcher & Luft, 2011; Tomanek, 1996; Tomanek & Cummings, 2000; van den Kieboom, McNew-Birren, Eckman, & Silver-Thorn, 2013). These studies featured small numbers of participants, ranging from a single-case narrative to 22 participants. Despite their small scale, these studies shed light on the importance of thoughtfully integrated field experiences for STEM undergraduates exploring or preparing for a teaching career.

In a study at North Dakota State University on recruiting academically talented science majors to consider a pre-college teaching career, Tomanek (1996) examined a program that placed students as interns or instructional aides in secondary science classrooms for 10 hours per week over 10 weeks. Although the study included 10 participants, the findings narrative focused primarily on the positive experience of one participant. In the discussion, Tomanek noted that the participant felt most satisfied interacting with high school students on a lab or group activity and much less satisfied with having to deal with class management problems. Despite the good experience, the participant did not choose to pursue a secondary teaching career. In an extension to the 1996 study, Tomanek and Cummings (2000) conducted a study with 15 participants and found that all the interns had positive teaching experiences and that classroom student interactions generated the most satisfaction. The 2000 article focused on the narratives of three participants who chose to enter a teacher education program. Tomanek and Cummings highlighted four factors that influenced these participants' decisions: (a) they liked and respected their mentor teachers, (b) they enjoyed their classroom interactions with students, (c) they felt important because they were a source of science knowledge, and (d) they believed teaching was a legitimate career choice for an academically talented science major.

Borgerding (2015) undertook a study exploring how a summer teaching internship influenced STEM majors' ideas about teaching science or math and interest in a teaching career. The internship duration was either three or five weeks, with fewer days per week in the latter. As evidenced in the individual case narratives and cross-case analysis of the

five participants in the study, Borgerding found that interest in teaching as a career was higher for (a) interns who found the experience more rewarding or perceived more growth, (b) interns who focused on student learning rather than student behavior, and (c) interns who developed close connections with students and appreciated their individuality. These findings suggest that field experiences that promote positive engagement along these three areas may entice more STEM undergraduates to consider becoming teachers.

In their study of an urban science teaching field experience, Bischoff et al. (2014) reviewed 22 students' reflective essays written following a week-long internship at high-need schools in New York City. Although these students were participants in a teacher preparation program that required them to teach science at high-need schools upon graduation, Bischoff et al. found that the experience was effective in persuading 16 of the students to consider seriously committing to teaching in an urban school. They found that the immersive experience enabled students to engage in careful reflection about themselves as science teachers, the city environment, and the schools in order to make an informed decision about their futures. The essays revealed that students who settled on teaching at urban schools had positive self-expectations of the experience, a proclivity for urban life, and positive perceptions of urban schools, whereas the six students who indicated a preference for non-urban settings voiced strong family ties or pulls toward their childhood communities. This study offers some consideration into the value of field experiences in informed decision-making when committing to a STEM teaching career.

In a study of one STEM teacher preparation program, van den Kieboom et al. (2013) demonstrated that an integrated science content and general pedagogy field experience model helped STEM undergraduates develop a strong base of knowledge that was particularly effective for transitioning STEM students into successful teachers. Drawing from the course assignments of two students who participated in the program and interviews with their educators, van den Kieboom et al. found that the integrated model facilitated the students' high-level development of subject- and pedagogical-content knowledge alongside experiential teacher knowledge, which then fostered their comfort with and adaptability to teaching in high-need schools. Although this study is informative, its reliance on two students' experiences suggests that a larger study similarly focused on the field component of integrated models is warranted.

Fletcher and Luft (2011) conducted a three-year longitudinal study following five secondary science teaching candidates from recruitment through their first year in the classroom. The study probed the contrast between reform-based approaches to science teaching (i.e., student-centered guided inquiry) versus traditional formats (i.e., teacher-centered information delivery). One of the research questions investigated how reform-based field experiences impacted these students' developing beliefs about teaching and learning. Fletcher and Luft found that when the field experience was structured around active reflection and the practice of reform-based teaching, beliefs shifted to a reform-based orientation. When the experience did not have such a focus, beliefs reverted back toward traditional notions about teaching. Based on their study, Fletcher and Luft called for more research examining how different types, sequences, and intensities of field experiences can impact teacher development.

The studies cited above highlight the relevance of field experiences within the narrower scope of STEM undergraduate teacher exploration and preparation programs. Findings include more positive attitudes toward science or math teaching careers, experientially informed decision-making about desired school settings, smoother knowledge-based transitions into high-need classrooms, and influences on beliefs about teaching and learning science. Information from these studies has helped STEM teacher recruitment initiatives, such as the UC CalTeach program, better position STEM undergraduates for teaching careers. Missing from the literature, however, are studies that examine the field experiences of STEM undergraduates with respect to social justice and SEL, which are important priorities in the realm of teacher preparation and understanding diverse learners (Darling-Hammond, 2006). The purpose of this study is to extend the research base of STEM undergraduate field experiences into the social justice and SEL space in order to contribute to the overall knowledge we have about early STEM teacher preparation efforts. Specifically, this study examines how a science and math teacher recruitment internship fostered a socioemotional and social justice-oriented understanding of teaching. The following research questions guided this study:

- (a) What socioemotional insights do STEM undergraduates develop about teaching?
- (b) How does the internship contribute to STEM undergraduates' understanding of social justice?

### **Social Justice Framework**

The increasing contemporary importance of social justice and SEL in the overall landscape of teacher preparation suggests an ongoing need for research that investigates these constructs (Schonert-Reichl, 2019; Wiedeman, 2002). This study endeavored to understand how a teacher exploration program intended to increase the state's supply of STEM teachers fostered participants' awareness of these constructs. In doing so, we can learn how to leverage early teacher exploration and preparation programs to reinforce these educational priorities. In this study, we draw on Schonert-Reichl et al.'s (2017) definition of SEL:

The process of acquiring the competencies to recognize and manage emotions, develop caring and concern for others, establish positive relationships, make responsible decisions, and handle challenging situations effectively. That is, SEL teaches the personal and interpersonal skills we all need to handle ourselves, our relationships, and our work effectively and ethically. (p. 17)

We see SEL as intersecting with the aims of social justice in that the core competencies of a teacher preparation program for social justice should also include goals of developing care and concern for others and establishing positive relationships. Indeed, across teacher education scholars' deliberations about pedagogies and practices that foster justice, a shared value is to establish relationships with students based upon care (Cochran-Smith, 2010).



Cochran-Smith's (2010) theory of teacher education for social justice informed the framework of this study. She conceptualized her theory along three guiding questions: What is justice (i.e., theory of justice)? What is teaching and learning practice that fosters justice (i.e., theory of practice)? What is teacher preparation that generates teaching practice that fosters justice (i.e., theory of teacher preparation)? The key ideas in the theory of justice are equity of learning opportunity, respect for social groups, and acknowledging and dealing with tensions. In the theory of practice, the foci are knowledge, asset-based (versus deficit-based) interpretive frames, methods and skills, and advocacy and activism. The central idea in the theory of teacher preparation is that it "is intended to challenge the educational status quo and be transformative" (p. 458). Recognizing that there may be "tensions among competing goals" (p. 447) along any of the dimensions comprising theories of justice, practice, and preparation, Cochran-Smith (2010) affirmed that teacher education for social justice is overall "a coherent and intellectual approach to the preparation of teachers that acknowledges the social and political contexts in which teaching, learning, schooling, and ideas about justice have been located historically" (p. 447).

In the context of this study, we further explicate the application of Cochran-Smith's (2010) theory of teacher preparation for social justice and its four additional questions: Who should teach (i.e., teacher selection)? What should teachers and students learn (i.e., curriculum and pedagogy)? How and from or with whom should teachers learn (i.e., contexts and structures)? How should this be assessed (i.e., outcomes)? On the question of who should teach, Cochran-Smith stipulated two criteria: a teaching force composed of diverse cultural, racial, and linguistic backgrounds and teachers "whose beliefs, experiences, and values are consistent with social justice goals" (p. 459). Given that the UCLA CalTeach program is a recruitment program, it serves as an apropos context in which to explore what social justice awareness the program might engender. In terms of how and from or with whom teachers learn, we utilized the summer field experience component of the program to illuminate how one programmatic element—the field experience—might contribute to the overall teacher preparation pipeline for STEM undergraduates and to develop awareness of the key ideas that Cochran-Smith outlined in the theory of justice and theory of practice within her overall theory of teacher education for social justice. In this way, the findings from this study can then inform the questions of what teachers should learn and how their learning should be assessed. Given the exploratory nature of our study, our aim was only to discover what social justice and SEL insights of STEM undergraduates would emerge from students who opted to spend a week interning in high-need schools. We did not aim to measure what the participants should be learning (i.e., curriculum and pedagogy) or whether or not they learned it (i.e., assessment of outcomes). Our purpose was to explore how an interest-based summer field experience prepared STEM undergraduate teaching recruits in ways that were consistent with the social justice framework that guided our study. Although these participants may or may not eventually enter a teaching profession, we can begin to understand the ways in which these types of field experiences can still serve the purpose of being transformative for those who take part in them (Cochran-Smith, 2010).

## **Method**

### **Study Site**

The UCLA CalTeach program offers undergraduates guided exploration of teaching as a career as well as additional support for students who decide to enter the teaching profession. While completing the requirements for their STEM undergraduate degrees, students in the program also take a sequence of pedagogy courses and are introduced to classroom teaching through placement in high-need schools. Curricular support includes weekly pedagogy seminars, minors in science education and teaching secondary mathematics, accelerated teaching credential programs in partnership with the UCLA Graduate School of Education & Information Studies, and support for subject-content preparation for credential exams. Field experiences include internships in elementary, middle, and high schools during the academic year and a summer internship program in classrooms in high-need middle and high schools with mentor teachers who have CalTeach program training. Through the Noyce scholarship program, UCLA CalTeach also offers financial assistance to participating students and mentor teachers.

The summer internship program is a paid, one-week internship in which STEM undergraduates get first-hand experience in a middle or high school classroom at a high-need school in the Los Angeles urban area. The majority of classroom teachers are UCLA alumni and serve as mentors. Due to the nature of UCLA's academic calendar, the internships took place in late September during the week before the university's fall quarter began. The middle and high schools started in August, so at the time of the internship they had only been in session for about four to six weeks. This timing gave interns a beneficial opportunity to see beginning-of-the-school-year activities. Interns attended an orientation session as a cohort on the UCLA campus on the first day of the internship, where program administrators discussed expectations, logistics, guidelines, and reflection assignments. Subsequently, interns spent four full days in the classrooms at the high-need schools. As a way of encouraging meaningful experiences, UCLA CalTeach staffers recommended that interns observe and think about three overarching areas: classroom organization and structure, teaching opportunities, and interpersonal relationships. As part of the internship, interns were required to complete two open-ended journal responses through an online portal for each of the four days of the internship (i.e., eight journal entries total per student). The journal prompts asked interns to (a) provide a detailed description of their daily experiences followed by (b) a reflection on them. The interns were also expected to attend a two-hour follow-up meeting on campus after the internship week to debrief and share their experiences. Although it was strongly preferred that interns had previous participation in at least one of the UCLA CalTeach pedagogy seminars, it was not a requirement. Therefore, for some interns it was their first exposure to classroom teaching as a profession, whereas for others it was not novel.

### **Participants**

This study utilized journal data from 126 undergraduates who participated in the internships during the summers of 2015 (42 students) and 2016 (84 students). Of the 126 participants, 69 had taken at least one UCLA CalTeach teaching and learning seminar (math or science) whereas 57 had not. Most participants were female, the mean age at the

time of the internship was 21, and nearly all participants self-reported their major as being in a STEM field (see Table 1).

Table 1

*Background Demographics of Students*

| Background Characteristic                   | Frequency | %    |
|---|-----------|------|
| <b>Gender</b>                               |           |      |
| Female                                      | 83        | 65.9 |
| Male  | 43        | 34.1 |
| Total                                       | 126       |      |
| <b>Race/Ethnicity</b>                       |           |      |
| Asian                                       | 48        | 38.1 |
| Hispanic or Latino                          | 35        | 27.8 |
| White                                       | 33        | 26.2 |
| Black or African American                   | 2         | 1.6  |
| Did not answer                              | 10        | 7.9  |
| Total                                       | 128       |      |
| <b>Age (at start of internship)</b>         |           |      |
| Mean  | 21.3      | -    |
| Mode  | 20        | -    |
| Median                                      | 21        | -    |
| <b>Major (upon application to CalTeach)</b> |           |      |
| Life sciences                               | 51        | 40.5 |
| Mathematics/statistics                      | 41        | 32.5 |
| Physical sciences                           | 26        | 20.6 |
| Engineering                                 | 6         | 4.8  |
| Linguistics                                 | 2         | 1.6  |
| Total                                       | 126       |      |

*Note.* Students may have identified more than one race/ethnicity category.

During the internship orientation session, program staff announced that the UCLA CalTeach program in collaboration with the UCLA Center for Educational Assessment would be conducting a study to learn about their experiences in the Noyce-funded program (IRB#15-001931). Staff provided participants with research information sheets detailing the study and informing interns of their benefits, risks, and rights as participants. Active data collection included pre- and post-surveys and in-person or telephone interviews. Passive data collection included existing data generated from the program, such as application materials, registrar data, and CalTeach assignments including journal entries. In order to maintain participants' confidentiality, all names used in this study are pseudonyms.

### **Data Analysis**

The journal entries assignment (eight journal entries total per student) was the primary source of data for this interpretive qualitative study (Merriam, 2002).

Participants were free to write as they desired based on the general prompts (i.e., provide a detailed description of your daily experiences followed by a reflection on them), though they were also given guiding questions related to classroom organization and structure, teaching opportunities, and interpersonal relationships. The cumulative daily entries per student ranged in total word count from a brief 282 words to a lengthy 5,636 words. The mean word count per student was 1,590 and the median was 1,320. In essence, the journal entries served as participatory field notes given that they documented daily activities, as well as recorded participants' insights and thoughts about each day (Creswell, 2003). Although other sources of data were gathered for this study, including documents, surveys, and reports, this article focuses on findings from the journal entries. We chose this limited scope because the journal entries were an incredibly rich source of data written in first-person voices. Given the time-intensive nature of qualitative analysis, we believed the 126 journal entries offered sufficient data to yield findings related to our research questions (Miles & Huberman, 1994). However, we acknowledge that our approach did not allow for a robust triangulation of findings. Furthermore, we also recognize that the short duration of the internship may be perceived as a limitation to our findings. On the other hand, it is also worth noting that practical findings stemming from a brief but intensive experience could suggest that the UCLA CalTeach program practices may be usefully replicated by other teacher recruitment and preparation programs.

All journal entries for each student were entered into ATLAS.ti 8.0.41 (ATLAS.ti Scientific Software Development GmbH, 2017), a qualitative data analysis software program. Analysis was initially deductive, informed by the social justice framework and a code list from Borgerding (2015). We opted to include the Borgerding code list because it served as a useful point of departure for determining coding reliability. Two authors coded the data, first working independently on a handful of entries and then comparatively to assess the interpretation of our codes. After we reached consensus with our deductive code interpretations, we coded all the remaining entries. As we coded, we routinely checked in with each other to discuss unexpected themes that arose from the data. We inductively generated additional codes and sub-codes and re-reviewed previously coded entries with new codes (see Appendix). Iterative coding involved a multi-step process of (re)reviewing participant responses and organizing the material into meaningful segments followed by themes (Creswell, 2003; Saldaña, 2009). Concurrently with coding, the lead author wrote a range of research memos. These included brief analysis notes and first impressions, extended annotations capturing emergent relationships and concepts, and substantive narratives about preliminary interpretive findings (Miles & Huberman, 1994).

### **Trustworthiness, Authenticity, and Positionality**

As opposed to the notions of validity and generalizability, the complementary constructs of trustworthiness and authenticity serve as guideposts for establishing rigor in qualitative studies following a naturalistic and interpretive paradigm (Lincoln & Guba, 1986; Manning, 1997; Schwandt, 2007). According to Lincoln and Guba (1986), four criteria address trustworthiness: credibility, transferability, dependability, and confirmability. We sought to establish trustworthiness and ensure the accurate representation of students' experiences and perceptions in multiple ways. We utilized

first-person data generated as part of an internship assignment and therefore reflected participants' first-hand accounts of their internship. The daily entries also established sustained engagement for the duration of the internship. We sought to capture the true meanings of students' reflections through a thick narrative of findings replete with the direct words of the participants (Denzin, 1989). Finally, we asked an external colleague to review our analysis process and work product (i.e., this manuscript) to ensure that the research design was sound.

With respect to authenticity, our decision to focus on the summer field experience and use the journal entries as our primary data source allowed us to establish the multiple *layers of authenticity* (Lincoln & Guba, 1986). The requirement for all internship participants to complete the journal entries as part of an assignment eliminated the likelihood of self-selection and established *fairness* of representation. The journal entries were a reflective assignment undertaken by the interns and encouraged them to develop greater self-understanding of their teaching potential (i.e., *ontological authenticity*). Through the design of the summer internship, participants were able to develop a raised level of awareness of the teaching profession and expand their perspectives about other stakeholders (e.g., middle or high school teachers and students; i.e., *educative authenticity*). The experience also enabled participants to take further action toward a teaching career. In other words, the experience had the potential to serve as a catalyst for a career pursuit (i.e., *catalytic authenticity*). Finally, the internship empowered participants to engage in positive action with members of a community (i.e., students and teachers) within a teaching environment (i.e., *tactical authenticity*). These layers of authenticity were inherent in the data and inquiry for this study, which allowed for findings to emerge naturalistically.

The role of the researcher is important to acknowledge in research design (Creswell, 2003). In this study, one of the authors maintains an insider role as the director of the UCLA CalTeach program. She is a chemist and senior lecturer with extensive experience in science teacher education. She proposed the idea of a study examining the field experiences component of the program and provided access to existing data. The other three authors possess outsider roles as a director and as qualitative research analysts working within a department of educational assessment at UCLA and do not have experience in the STEM fields. The analysts designed the study, gathered additional data, and conducted the analysis. We do not have experience teaching in middle or high schools. We acknowledge that, as researchers, we sit removed from the day-to-day experiences of teachers and their students. However, we are educational researchers committed to learning and understanding as much as we can about the educational process, including teacher training. In our aim to let the data speak, we foreground the words of the participants in response to the research questions for this study.

### Findings

In response to our research questions and guided by our framework, our findings centered on two key themes: socioemotional perceptions and social justice awareness. The valuable experience with classrooms allowed interns to understand the importance of connecting with students and developing positive and constructive relationships with them via firsthand experience. The setting of high-need schools exposed interns to the

benefits and challenges encountered by the students and the schools. Through a narrative of findings primarily in the students' own words, we first present the SEL perceptions that interns articulated with respect to relating one-on-one with students, being caring and compassionate, encouraging students positively, accommodating varying capabilities, and supporting one another. We then present interns' developing social justice awareness with respect to equity of learning opportunities, asset-based interpretive frames, recognition of privilege, and advocacy and activism.

### **Socioemotional Perceptions**

In a 2013 TED Talk, lifelong educator Rita Pierson advocated for the "value and importance of human connection," stressing that "every child deserves a champion, an adult who will never give up on them, who understands the power of connection, and insists that they become the best that they can possibly be" (Pierson, 2013, 1:02 & 7:14). Many interns articulated these sentiments, demonstrating their sense of compassion for the students in their classrooms, capability for earning student trust, and desire to inspire and be inspired by students.

**Relating one-on-one.** As a testament to the "power of connection," many interns used the words "wonderful" and "amazing experience" when describing their involvement in "getting to know and help students." Many also affirmed how much they "enjoyed working with the students." The interns' reflections illustrate the gravity of building personal relationships and being able to relate one-on-one with students. Samantha shared, "Making relationships and sharing experiences with new people allows for connections that are forever cherished. . . . The kids really make me excited to be the best version of myself and the best role model I can be." George discovered that teaching concerns more than subject content and recognized that connections are key:

My initial thoughts were that I was good at math so I would become a tutor. I became a pretty good tutor, so I thought about teaching, but there's another whole dimension to it. You have to be able to connect with the students and there's more to teach than just math. I think this experience has inspired me to want to teach more because I want to help these students: a) get really good at math/start enjoying math, b) become better students, [and] c) become better people.

Other interns suggested that developing bonds with students can lead to more productive educational environments. Jessica commented, "The one-on-one with students is always nice because it helps develop a relationship with the students, and they seem to respond better when they like you and when you show interest and respect in them." It can also help students feel educationally secure, as Frank expressed, "I can see how important the student-teacher relationship has to be such that the class environment is one of learning, and the students are therefore not afraid to ask questions or make mistakes." Evan similarly acknowledged that getting to know students would make the job easier:

During advisory period, we had a time called "What's up Wednesday" where the group of seniors talked about their "highlights and lowlights" of the week. It was

nice for me to listen in on this because it showed me how if a teacher creates a relationship with the students, how much easier the teacher's job will be.

Furthermore, Jessica noted that the shared backgrounds between teachers and students can also be advantageous:

All the students responded well to me because we had similar identities. I knew their background; I drive on the same roads as they do with their families and friends. The connection part helped a lot and gave more credibility to me trying to tell them what to do. They were receptive and respectful.

The sentiments from these interns demonstrated their efforts to engage more closely with students and to also understand their lives outside of school.

**Being caring and compassionate.** When discussing student relationships, interns described affirmative interpersonal approaches, recognizing that being compassionate and caring is fundamental to teaching. Jeremy noted, "Although teaching is hard, at the end of the day, you are impacting the lives of kids and [you] have an awesome opportunity to give them hope, encouragement, and love where you may not realize there is a need." After witnessing a student in tears, Chiara proclaimed:

It was a moment like this where I could feel how compassionate you need to be when you are a teacher. You never really have any idea what people are dealing with at home and the most important thing you can do is be sensitive to another person's issues.

Miriam and Gladys similarly articulated, respectively, that they "want [students] to know that someone is there and someone cares" and that they realize just "how quick and easy it is to care for the students, to desire their success (as exasperating as they sometimes are)." Interns also recognized the importance of modeling care. Tonya commented, "Teaching should not be a superior versus inferior relationship. No teacher can demand respect, but they can show what respect is and how respect can be earned." Even in situations that may initially be fraught with anxiety, being considerate was vital. Jeremy revealed:

Although I was uncomfortable and nervous about how to manage the more rowdy kids, I thought I did a good job of asserting my authority in the large group setting while also being respectful, caring, and gentle in a one-on-one setting.

**Encouraging students positively.** In addition to compassion and care, interns communicated the importance of positively advocating for students. Along with wanting students, as Alice noted, "to know they can do anything, no matter what the world around them is saying," interns such as Joshua expressed a desire to give "students hope that they can succeed because others (teacher, family, friends, etc.) believe in them along with them believing in themselves." Terry optimistically felt that "every student just needs a

little attention and motivation and they will want to do their best.” This paralleled Nancy’s sentiment that it was “so heartening to see ‘problem students’ not being ignored as just ‘problem students’ and instead being given the attention and help they need.”

Beyond instilling confidence in students, other interns like Charles believed that “the teacher should be someone who walks by the students’ side, not someone who carries them by force.” Liam framed it as “proper guidance” and Faith specified that with “some direction,” students are all “capable of problem-solving.” Though, Gladys noted the challenges of this in practice:

It was so important to be both patient with the student and with myself. Moreover, I struggled to lead them to understand concepts on their own, and not simply give them the answer. Much of this simply involved gentle nudging in the right direction (it’s a lot tougher than it sounds).

Despite being harder than it may appear, Gladys also conveyed the consequent joy, “But each moment of revelation and every ‘ohhhhh’ gave such a satisfying feeling that I quickly learned to cherish.” The interns’ experiences of developing their connections to students demonstrated how quickly bonds can develop. As Ellie commented:

The students seem to be much more comfortable with me after just two days, and I believe I have earned their trust. I no longer had to ask to help them; they felt comfortable enough to initiate it themselves as needed.

For these interns, they felt that advocating for students in a positive way would be the desirable way to encourage students to achieve.

**Accommodating varying capabilities.** The recognition that students have different learning styles and may be at variable academic levels demonstrated to interns the importance of tailoring and refining the lessons. Jasmine relayed her mentor teacher’s emphasis on “assessing prior knowledge—before you begin instructing—you must understand where is your class at and meet them at that level.” Delighted in having “the luck to observe the same lesson being taught with only the students changing” between four distinct classes—biology repeat students, regular biology students, honors biology students, and selective honors biology students—Vivian proclaimed that, “this was a powerful teaching tool because I was able to see just how different the lesson became depending on the needs of the students who heard it.” Jenna was “impressed throughout the day with how much [the teacher] individualized her teaching. She knew each student and knew what they might need throughout the day in terms of encouragement and motivation.” For Frank, he asserted:

Teaching requires a great ability to make subtle observations regarding where students struggle. Subtle points, such as the speed or lack thereof at which a student is writing, or which students work well with certain students, are extremely important observations to talk and think about with other teachers who have those same students. In this way, behavioral patterns for each student can be understood more deeply, and difficulties the students might be having in class can be addressed.



Through observations of their mentor teachers in action, interns displayed deeper awareness of the significance of contextualizing pedagogy and meeting students at their respective needs.

**Supporting one another.** As a reflection of Pierson's statement that "every child deserves a champion" (Pierson, 2013, 7:14), the interns recognized how students and teachers supported each other to create a caring classroom environment. Fiona admired the following:

What surprised me the most and made me really happy is that all the students were very willing to help each other. . . . One of my favorite moments was when one of the students finished the problem a bit early, but she noticed that her other group members had not yet finished. She made sure to wait until everyone had finished, and she also offered help and asked questions to make sure that the other students in her group understood the problem.

Oliver was amazed by how students "were very encouraging with each other," noting the ways they were "lifting each other up, by giving each other compliments on getting the right answer and improvement of their work." For Oliver, this demonstrated that "the students here care about each other just as much as everyone else cares for them." Other interns applauded their mentor teachers' goodwill, including Jeremy who "was really impressed" by a teacher who set aside time during his free period to play tennis with students. Jeremy felt such action "is what separates a good teacher from a great teacher. They desire spending time with their students and doing something that makes the student feel loved and valued." For these interns, their SEL insights also extended to their observations of the interpersonal interactions of students with students and students with teachers in and out of the classroom.

### **Social Justice Awareness**

From their time at the schools, interns reflected on the challenges they perceived facing the schools and their students. These included difficulties related to languages spoken, economic conditions, and family situations. Interns also recognized the importance of cultivating empathy and encouragement when interacting with students and noted their own educational privileges relative to students at the internship schools. The experience provided interns with a meaningful opportunity for beginning the process of examining educational inequity.

**Equity of learning opportunities.** Several interns described the experience at the high-need schools as an "eye-opening" one, noting the differences in resources and support available to students at these schools compared to the ones they had attended. Although there were a few interns who had a more negative outlook, commenting as Natalie did that "many of the students were very disruptive and rowdy, so [it] was an unpleasant atmosphere," far more interns recognized, as Jasmine and Rocky did, respectively, the "very real barriers that these students face" and the "structural factors" at play that could lead to underperformance in school. Ellie remarked:

In complete honesty, I experienced a bit of culture shock today. I was raised in a very affluent area with very little diversity. I did not realize how difficult it must be for students with language barriers, economic hardships, etc., until I witnessed it firsthand—albeit for a short time period. This first day opened my eyes to a lot of the struggles within LA Unified, for both students and teachers, which I have heard about but not actually experienced.

Ellie's sentiment captured the disquiet that teachers may face when called to teach at a school that does not reflect their own experiences and the utility of having firsthand knowledge of inequitable educational environments.

With respect to language barriers, rather than criticizing students for their lack of English fluency, interns such as Eden and Jasmine remarked respectively that “being bilingual and fluent in another language is essential when working within the classroom” and acknowledged “how imperative/helpful it is to know Spanish if you are a teacher at an urban school in Los Angeles.” Eden also recognized the value of better preparing oneself for potential language challenges:

I had never experienced having a classroom where a student does not understand the language, so I had not thought of learning mathematical terms in Spanish. Now, I am considering taking a math course at a community college that is offered in Spanish. I believe learning a math course in another language than I am used to would be beneficial in mirroring what some students will be experiencing.

For Eden, the experience of being in a classroom where students may be predominantly fluent in a language other than English seems to have inspired a drive to seek extra teaching preparation.

The interns also observed that services ranging from the seemingly ordinary, such as the availability of a free breakfast, which Eden noted was a “brilliant program to have since so many students go to school hungry,” to exceptional circumstances, such as homelessness and what Aaron described as “volatile home situations,” can influence the learning environment. The interns shared that in addition to school difficulties stemming from external factors, such as family responsibilities or lack of home or familial stability, challenges in the classroom can also arise from students' uneven prerequisite preparation. Jasmine commented:

If a student cannot read  $4 + 3 \times 6$ , that gives you, the teacher, vital information about your student's level of understanding. I learned how important this principle is especially in an urban school, as many of the students are coming from middle schools where they were not given the basic knowledge and foundation that they need to be properly equipped for high school material.

The interns' growing understanding of varying factors related to students' school preparedness highlights the inequity of learning opportunities that exist when students travel through a pipeline of instability and/or under-resourced schooling.

**Asset-based interpretive frames.** Though there may be some students who appeared underprepared for their current grade level, the interns also recognized students' capacity for learning, noting as Frank did, "It must never be implied that these students . . . are incapable of learning complex subject matter." Interns, such as Jasmine, also reflected on the self-doubt of students, having seen them "struggle with motivation and confidence in their abilities." Miles emphasized:

Many of the students that I worked with one-on-one doubted their intelligence and academic abilities, and it isn't because they are lacking in these areas; it's because they haven't been encouraged enough. I realized this because they all have the ability to solve the problems they are faced with in the classroom; it's just that they doubt themselves so much they don't even try. The important part is getting them over that hump.

These interns' attribution of student underperformance to lack of confidence and encouragement rather than aptitude suggests a compassionate rather than dismissive attitude toward students.

In addition to offering insight into student challenges, the data revealed the perspectives of teachers at high-need schools. For example, Charles and Eden noted respectively that their mentor teachers stressed the "understanding of students' needs" and "importance of patience." Aaron elaborated, "[Her] teaching style is 'kill them with kindness and structure.' She was very aware that many of her students come from underperforming academic backgrounds. As a result, it's her job to be empathetic towards them and build their confidence." Though her mentor teacher told Kitty that teaching in a high-need environment "can be chaotic," her mentor also affirmed that it is "rewarding and there's never a dull moment." For Kitty, seeing "how inspiring a disadvantaged student to succeed can be intensely gratifying" has encouraged her. She commented, "At first, I wasn't fully comfortable with the idea of teaching in an urban school like [this one], but I now feel like I could do it with experience and practice and probably come to enjoy it very much." Even Natalie, who initially assessed that students were "disruptive and rowdy," pronounced that the experience "makes me want to help students become more passionate about learning."

**Recognition of privilege.** Through this experience, the interns also exhibited some self-awareness about their privilege and lamented that there were not enough resources and support for students at high-need schools. Sawyer stressed, "Students need equity, not equality. Students who were not born with the same privileges and resources that I was blessed with need a whole lot more support and structure that they're not getting in junior high or high school." Sawyer recognized that these students often "work double, triple times harder than other students who did benefit from having a privileged life." The interns' cognizance of privilege not only addressed students' current educational context but also extended to the pursuit of higher education. Thomas observed:

From many of the students' questions today, I can tell that many of the students are interested in attending college but do not necessarily have the same resources that I had. They often ask how I got in and what it is like. If some of these

students [go] to college, they may be the first in their family and have little support.

The interns valued the opportunity to talk to students about college, with Mackenzie revealing, “I was able to further understand the obstacles these students have to overcome and realized how privileged I was to grow up in an area where college was an expectation, not an option.”

**Advocacy and activism.** The immersion in high-need school environments exposed interns to a spectrum of challenges facing students, teachers, and schools, including limitations with English language fluency, impacts of accumulated schooling disadvantage, difficulties of external circumstances, and pains of internalized doubts and lack of self-confidence. This seemingly downcast context led Ike to reflect:

I was dismayed by my time at [this school] more than I was heartened. I’m saddened to know that what I saw passes for “education.” I’m saddened to know that many of these students have already given up on themselves. I’m most saddened to know that I don’t know how this problem can be fixed.

But the experience also provided interns with a sense of purpose and optimism, as they witnessed the benefits of bilingualism, the desire and capacity of students to achieve, and the ability of teachers to make a difference. Despite not knowing how to fix the problem, Ike also noted, “That’s what I’m hoping to learn as I continue on my path in education, and I’m grateful this program brought it to my attention.”

### **Discussion and Implications**

Guided by our social justice framework, our analysis of interns’ journal entries revealed that their summer field experience allowed them to develop a substantive level of socioemotional perceptions and social justice awareness. The week-long internship allowed for first-hand reflection on educational inequity and highlighted the commitment required from teachers to counter the imbalance. As expressed by many interns, their observations seemed to testify to Pierson’s emphasis on the “value and importance of human connection” (Pierson, 2013, 1:02) a key element of SEL. Compassion, care, positivity, and attentiveness can impact the educational environment, including student trust and learning. Supportive interpersonal approaches can also be self-affirming, such that investing in students is also about investing in oneself. Despite the field experience’s brevity, the interns were able to witness firsthand how meaningful personal attention is for students and to be introduced to the dynamics of classroom social bonds. This exposure provided these interns with an advantage over those without early field experiences. In this way, these interns are perhaps primed to enter a teaching program, especially one with a mission of ensuring social justice in education.

Undergraduate STEM students have been found to exhibit fewer social agency outcomes—a construct that captures socially and civically minded competencies central toward promoting educational equity—compared to non-STEM peers (Garibay, 2015). In light of this finding, the social justice awareness that arose for interns in this study speaks to the importance of these types of field experiences in cultivating a pool of social

justice-oriented science and math teaching recruits. The acquaintance with and experience in high-need schools offered an occasion for interns to reflect experientially—in terms of their own educational privileges and from their field time in the classrooms—on educational inequities confronting schools and students. It also provided an early opportunity for those exploring a teaching career to begin developing and addressing the emotional, positional, and critical agency that permeates social justice science teacher identities (Moore, 2008; Rivera Maulucci, 2013).

Given that field experiences can shape developing beliefs about teaching and learning (Fletcher and Luft, 2011; Hancock & Gallard, 2004; Whang-Sayson, Daniel, & Russell, 2017, Wilson, 1996), a teaching exploration program, such as UCLA CalTeach, in which STEM undergraduates develop skills such as empathy, care, and respect for social groups, further highlights this important context in the teacher preparation continuum. Teacher educators and teacher education researchers, such as Noddings (2012) and Talbert-Johnson (2006), have emphasized that creating a climate of trust that allows caring relations to blossom should be the goal for all teachers and educational policymakers. Furthermore, positive dispositions are crucial, particularly in urban contexts, to becoming an effective and affective teacher. For those considering a profession in science or math teaching, the findings indicate the power that connecting with students and the ability to empathize and care for them serve as important preparation for the realities of teaching. McAllister and Irvine (2002) stressed that empathetic frames of mind enacted through positive interactions, supportive classroom climates, and student-centered practices were important qualities for teachers working with culturally diverse students. This type of “intentional preparation” (Kirchhoff & Lawrenz, 2011, p. 257) holds the potential to positively impact STEM students’ considerations for teaching in high-need schools with culturally diverse populations. The availability of these experiential opportunities at the career exploration stage also provides STEM undergraduates with strategic career and pedagogical preparation.

From a policy and practice standpoint, findings from this study can inform institutions in multiple ways. First, university systems can use the UCLA CalTeach model as a guide for establishing cross-campus student pipelines to math and science teaching credentials. Second, universities can leverage best practices from the UCLA CalTeach program, such as incorporating a brief but integrated, intensive, and immersive field experience. Third, in order to drive future policy and practice improvements, future research along this line of inquiry should include longitudinal studies examining the ways in which the momentum from this internship experience propels interns into teacher education programs, and the impact it may have on the quality of their teaching as they enter and persist in the profession. If particular undergraduate experiences are important in producing good STEM teachers, then the goal of teacher exploration and recruitment programs should not be just to find potential STEM teachers, but to develop dynamic, effective, and reflective educators who can be instrumental in the development of a social justice-oriented culture of science in service toward our national scientific literacy.

### **Author Biographies**

**Amy Liu** is a researcher with the Center for Educational Assessment and lecturer in the Graduate School of Education & Information Studies at the University of California, Los Angeles.

**Shannon Toma** is a former researcher with the Center for Educational Assessment, University of California, Los Angeles.

**Marc Levis-Fitzgerald** is the director of the Center for Educational Assessment, University of California, Los Angeles. He leads several undergraduate science initiative assessment projects funded by NSF and HHMI.

**Arlene A. Russell** is a tenured senior lecturer in both the Department of Chemistry and Biochemistry and in the Department of Education at the University of California, Los Angeles. She is also the faculty director of the UCLA CalTeach program.

This research was supported in part by a grant from the National Science Foundation Award 1035164. The authors would like to acknowledge Janice Daniel for culling the original student data reflections from the system-wide CalTeach portal and organizing them for analysis by the UCLA Center for Educational Assessment, and the University of California Office of the President for financial support for the CalTeach program and its evaluation.

### References

- American College Testing, Inc. (2015). *The condition of future educators 2015*. Retrieved from <http://www.act.org/content/dam/act/unsecured/documents/Future-Educators-2015.pdf>
- Bang, E., Kern, A. L., Luft, J. A., & Roehrig, G. H. (2007). First-year secondary science teachers. *School Science and Mathematics*, 107, 258–261. <https://doi.org/10.1111/j.1949-8594.2007.tb18287.x>
- Beck, J. (2015, January 29). Americans believe in science, just not its findings. *The Atlantic*. Retrieved from <https://www.theatlantic.com/health/archive/2015/01/americans-believe-in-science-just-not-its-findings/384937/>
- Bischoff, P., French, P., & Schaumlöffel, J. (2014). Reflective pathways: Analysis of an urban science teaching field experience on Noyce scholar-science education awardees' decisions to teach science in a high-need New York City school. *School Science and Mathematics*, 114, 40–49. <https://doi.org/10.1111/ssm.12057>
- Borgerding, L. A. (2015). Recruitment of early STEM majors into possible secondary science teaching careers: The role of science education summer internships. *International Journal of Environmental & Science Education*, 10(2), 247–270. <https://doi.org/10.12973/ijese.2015.244a>
- Cochran-Smith, M. (2010). Toward a theory of teacher education for social justice. In A. Hargreaves, A. Lieberman, M. Fullan, & D. Hopkins (Eds.), *Second International Handbook of Educational Change* (Vol. 23; pp. 445–467). Dordrecht, Netherlands: Springer.
- Cochran-Smith, M., Villegas, A. M., Abrams, L., Chavez-Moreno, L., Mills, T., & Stern, R. (2015). Critiquing teacher preparation research: An overview of the field, part II. *Journal of Teacher Education*, 66, 109–121. <https://doi.org/10.1177/0022487114558268>
- Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks, CA: Sage Publications.
- Darling-Hammond, L. (2006). Constructing 21st century teacher education. *Journal of Teacher Education*, 57, 300–314. <https://doi.org/10.1177/0022487105285962>
- Darling-Hammond, L., Furger, R., Shields, P., & Sutcher, L. (2016). *Addressing California's emerging teacher shortage: An analysis of sources and solutions*. Palo Alto, CA: Learning Policy Institute.
- Darling-Hammond, L., Koppich, J. E., & Merseth, K. K. (2000). *Studies of excellence in teacher education: Preparation in a five-year program*. Washington, DC: American Association of Colleges for Teacher Education.
- Darling-Hammond, L., Macdonald, M. B., Snyder, J., Whitford, B. L., Ruscoe, G., & Fickel, L. (2000). *Studies of excellence in teacher education: Preparation at the graduate level*. Washington, DC: American Association of Colleges for Teacher Education.
- Darling-Hammond, L., Zeichner, K., Miller, L., & Silvernail, D. (2000). *Studies of excellence in teacher education: Preparation in the undergraduate years*. Washington, DC: American Association of Colleges for Teacher Education.

- DeBoer, G. E. (2000). Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform. *Journal of Research in Science Teaching*, 37, 582–601. [https://doi.org/10.1002/1098-2736\(200008\)37:6<582::AID-TEA5>3.0.CO;2-L](https://doi.org/10.1002/1098-2736(200008)37:6<582::AID-TEA5>3.0.CO;2-L)
- Denzin, N.K. (1989). *Interpretive interactionism*. Newbury Park, CA: Sage Publications.
- Feiman-Nemser, S. (2001). From preparation to practice: Designing a continuum to strengthen and sustain teaching. *Teachers College Record*, 103, 1013–1055. <https://doi.org/10.1111/0161-4681.00141>
- Fletcher, S. S., & Luft, J. A. (2011). Early career secondary science teachers: A longitudinal study of beliefs in relation to field experiences. *Science Teacher Education*, 95, 1124–1146. <https://doi.org/10.1002/sce.20450>
- Garibay, J. C. (2015). STEM students' social agency and views on working for social change: Are STEM disciplines developing socially and civically responsible students? *Journal of Research in Science Teaching*, 52, 610–632. <https://doi.org/10.1002/tea.21203>
- Guarino, C. M., Santibañez, L., & Daley, G. A. (2006). Teacher recruitment and retention: A review of the recent empirical literature. *Review of Educational Research*, 76, 173–208. <https://doi.org/10.3102/00346543076002173>
- Hancock, E. S., & Gallard, A. J. (2004). Preservice science teachers' beliefs about teaching and learning: The influence of K-12 field experiences. *Journal of Science Teacher Education*, 15(4), 281–291. <https://doi.org/10.1023/B:JSTE.0000048331.17407.f5>
- Henke, R. R., Zahn, L., & Carroll, C. D. (2001). *Attrition of new teachers among recent college graduates: Comparing occupational stability among 1992–93 graduates who taught and those who worked in other occupations* (NCES 2001–189). Washington, DC: U.S. Department of Education, National Center for Education Statistics.
- Hollins, E. R., & Guzman, M. T. (2005). Research on preparing teachers for diverse populations. In M. Cochran-Smith & K. M. Zeichner (Eds.), *Studying teacher education: The report of the AERA Panel on Research and Teacher Education* (pp. 477–548). Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.
- Hyde-Keller, O. (2017, February 16). Questions for Ken Miller: Science denial, from evolution to climate change to vaccines. Retrieved from <https://news.brown.edu/articles/2017/02/miller>
- Ingersoll, R., Merrill, L., & May, H. (2014). What are the effects of teacher education and preparation on beginning teacher attrition? *CPRE Research Reports*. Retrieved from [http://repository.upenn.edu/cpre\\_researchreports/78](http://repository.upenn.edu/cpre_researchreports/78)
- Kirchhoff, A., & Lawrenz, F. (2011). The use of grounded theory to investigate the role of teacher education on STEM teachers' career paths in high-need schools. *Journal of Teacher Education*, 62, 246–259. <https://doi.org/10.1177/0022487110397840>
- Lincoln, Y. S., & Guba, E. G. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. *New Directions for Program Evaluation*, 30, 73–84. <https://doi.org/10.1002/ev.1427>
- Manning, K. (1997). Authenticity in constructivist inquiry: Methodological considerations without prescription. *Qualitative Inquiry*, 3, 93–115. <https://doi.org/10.1177/107780049700300105>
- McAllister, G., & Irvine, J. J. (2002). The role of empathy in teaching culturally diverse students. *Journal of Teacher Education*, 53, 433–443. <https://doi.org/10.1177/002248702237397>
- Merriam, S. B. (2002). Introduction to qualitative research. In S. B. Merriam (Ed.), *Qualitative research in practice: Examples for discussion and analysis* (pp. 3–17). San Francisco, CA: Jossey-Bass.



- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Thousand Oaks, CA: Sage Publications.
- Mills, C., & Ballantyne, J. (2016). Social justice and teacher education: A systematic review of empirical work in the field. *Journal of Teacher Education*, 67, 263–276. <https://doi.org/10.1177/0022487116660152>
- Moore, F. M. (2008). Agency, identity, and social justice education: Preservice teachers' thoughts on becoming agents of change in urban elementary science classrooms. *Research in Science Education*, 38, 589–610. <https://doi.org/10.1007/s11165-007-9065-6>
- National Science Board. (2016). *Science and engineering indicators 2016*. Arlington, VA: National Science Foundation (NSB-2016-1).
- Newton, X. A., Jang, H., Nunes, N., & Stone, E. (2010). Recruiting, preparing, and retaining high quality secondary mathematics and science teachers for urban schools: The CalTeach experimental program. *Issues in Teacher Education*, 19(1), 21–40.
- Noddings, N. (2012). The caring relation in teaching. *Oxford Review of Education*, 38, 771–781. <https://doi.org/10.1080/03054985.2012.745047>
- Pierson, R. (2013, May 3). Every kid needs a champion [TEDTalks]. Retrieved from <https://www.youtube.com/watch?v=SFnMTHhKdkw>
- Rivera Maulucci, M. S. (2013). Emotions and positional identity in becoming a social justice science teacher: Nicole's story. *Journal of Research in Science Teaching*, 50, 453–478. <https://doi.org/10.1002/tea.21081>
- Saldaña, J. (2009). *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage Publications.
- Schonert-Reichl, K. A. (2019) Advancements in the landscape of social and emotional learning and emerging topics on the horizon. *Educational Psychologist*, 54, 222–232. <https://doi.org/10.1080/00461520.2019.1633925>
- Schonert-Reichl, K. A., Kitil, M. J., & Hanson-Peterson, J. (2017). *To reach the students, teach the teachers: A national scan of teacher preparation and social and emotional learning*. A report prepared for the Collaborative for Academic, Social, and Emotional Learning (CASEL). Vancouver, BC: University of British Columbia.
- Schwandt, T. A. (2007). Judging interpretations. *New Directions for Evaluation*, 114, 11–14. <https://doi.org/10.1002/ev.223>
- Sleeter, C. (2008). Preparing White teachers for diverse students. In M. Cochran-Smith, S. Feiman-Nemser, & D. J. McIntyre (Eds.), *Handbook of research on teacher education* (3rd ed., pp. 559–582). New York, NY: Routledge.
- Sleeter C., E., & Owuor, J. (2011). Research on the impact of teacher preparation to teach diverse students: The research we have and the research we need. *Action in Teacher Education*, 33, 5–6. <https://doi.org/10.1080/01626620.2011.627045>
- Talbert-Johnson, C. (2006). Preparing highly qualified teacher candidates for urban schools. *Education and Urban Society*, 39, 147–160. <https://doi.org/10.1177/0013124506293321>
- Tomanek, D. (1996). Creating interest in teaching: Science classroom experiences for academically talented college science majors. *Journal of Science Teacher Education*, 7, 213–225. <https://doi.org/10.1007/BF00117036>
- Tomanek, D., & Cummings, K. E. (2000). The use of secondary science classroom teaching assistant experiences to recruit academically talented science majors into teaching. *Science Education*, 84, 212–227. [https://doi.org/10.1002/\(SICI\)1098-237X\(200003\)84:2<212::AID-SCE5>3.0.CO;2-P](https://doi.org/10.1002/(SICI)1098-237X(200003)84:2<212::AID-SCE5>3.0.CO;2-P)
- UC CalTeach. (2017). Impact. Retrieved April 30, 2020, from <https://calteach.universityofcalifornia.edu/impact/>

- University of California Office of the President. (2017). *CalTeach science and math teacher initiative: 2015–16 program highlights report*. Oakland, CA: University of California Office of the President.
- van den Kieboom, L. A., McNew-Birren, J. C., Eckman, E. W., & Silver-Thorn, M. B. (2013). Field experience as the centerpiece of an integrated model for STEM teacher preparation. *Teacher Education and Practice*, 26(2), 339–355.
- Whang-Sayson, H., Daniel, J. C., & Russell, A. A. (2017). A serendipitous benefit of a teaching-exploration program at a large public university: Creating a STEM workforce that supports teachers and public education. *Journal of College Science Teaching*, 47, 24–30. [https://doi.org/10.2505/4/jcst17\\_047\\_01\\_24](https://doi.org/10.2505/4/jcst17_047_01_24)
- Wiedeman, C. R. (2002). Teacher preparation, social justice, equity: A review of the literature. *Equity & Excellence in Education*, 35, 200–211. <https://doi.org/10.1080/713845323>
- Wilson, J. D. (1996). An evaluation of the field experiences of the innovative model for the preparation of elementary teachers for science, mathematics, and technology. *Journal of Teacher Education*, 47(1), 53–59.
- Wilson, S. M., Floden, R. E., & Ferrini-Mundy, J. (2001). *Teacher preparation research: Current knowledge, gaps, and recommendations*. Seattle, WA: Center for the Study of Teaching and Policy. <https://doi.org/10.1177/0022487196047001009>
- Wolf, L. (2015). *The STEM teacher drought: Cracks and disparities in California's math and science teacher pipeline*. Oakland, CA: The Education Trust-West.

## Appendix

### Codes and Sub-codes

#### Appreciation

- Appreciation for CalTeach
  - Describes how much interns appreciated this experience/program (e.g., “I was glad to have been given this opportunity and am very pleased with the experience. I would have loved to have continued this for a much longer time to really get the full experience of an educator.”).
- Appreciation for teaching
  - Intern’s appreciation for the teaching profession.

#### Connection to Content

- Learning
  - Described learning subject himself or herself (e.g., “I really didn’t know most of the material because I didn’t take half the classes, so I was learning with the students.”).
- Passion
  - Passion or interest in subject matter (e.g., “What I learned about science teaching today is how much I am passionate about teaching a topic I am interested in.”).

#### Focus of Intern’s Attention

- Behavior
  - Student behavior, respect, or task completion (e.g., “Also the students were much more talkative today.”).
- Learning

- Student understanding or learning (e.g., “They had a bit [of] a difficult time figuring out a climate’s classification using the guide.”).
- Motivation
  - Student motivation or engagement (e.g., “I would like to know how to inspire students to want to work hard to help themselves.”).

#### Focus on Teaching Knowledge

- Environment
  - Describes the classroom physical environment, such as how the classroom is decorated (e.g., “There was a ‘college wall’ which had banners from various colleges. It also had charts on ‘how to get to college.’ There was also a ‘culture wall’ where [Teacher] had placed flags from the different countries the students and their families were from.”).
- Management
  - Describes various classroom organization and management (i.e., discipline) strategies teacher uses (e.g., “I really like the group system she uses and would implement it if I became a teacher.”).
- Organization
  - Describes overall school/organization activities (e.g., “I attended the teachers meeting along with my mentor teacher. During this meeting, the teachers discussed the California standards and what passing rate they hoped schools would achieve as compared to the actual passing rates. They compared other middle school’s passing rates with [School] Middle School’s and thought about what things they might do differently.”).
- Pedagogy
  - Describes various pedagogical strategies that teacher uses (e.g., “My mentor teacher and the biology teacher were telling me about project-based learning and the program called Project Lead the Way, and I think that the layout and platform of that program is really amazing.”).
- Technology
  - Describes the various technological tools teacher uses.

#### Interest in Teaching Career

- Decreasing
  - Decreasing interest in teaching as a career (e.g., “It doesn’t seem like something that I would willingly do.”).
- Focused
  - More focused interest in teaching career (e.g., student now knows that she wants to teach high school and not middle school).
- Increasing
  - Increasing interest in teaching as a career (e.g., “It wasn’t my first option but now it’s higher up on the list.”).

#### Intern Activity

- Agency
  - Intern taught, managed, or took leadership role (e.g., “I suggested to the teacher that we separate the students into the project groups.”).
- Assigned
  - Mentions assigned activities (e.g., embedded tutoring, class/assignment prep, exam grading).

- Assisted
  - Intern assisted teacher or others or took on a supporting role (e.g., “During this time we helped [the teacher] get his room together for back to school night.”).
- Collaboration
  - Mentions collaboration with intern or teacher or using faculty feedback (e.g., “[Intern] and I led the class today.”).
- Deferral
  - Intern deferred to others when tasks needed to be done (e.g., “Somebody needs to tell the class that the MATHTECH program will help them build their basic math skills.”).

#### Organizational Issues

- Internship
  - Perceived systemic or organizational challenges related to the internship or intern but not directly impacting the students or teachers at the school (e.g., “This summer internship was held at the wrong time to properly observe the students in the robotics course. There wasn’t much teaching going on at this point because the students just spent the time working in their groups trying to get their project done.”).
- School
  - Perceived systemic or organizational challenge within the school or classroom (e.g., mentor teacher is responding to the challenge of teaching a double-enrolled course that has both regular and AP honors students).

#### Perceptions of . . .

- Students: All
  - Speaks of students as all possessing particular traits (e.g., “One thing I noticed is that the students in that class don’t respect the interns or the teacher.”).
- Students: Individual
  - Speaks of students as being individuals, not all alike (e.g., “Even though there were many students talking, some were working real hard on their math problems.”).
- Self-growth
  - Describes own growth in teaching competence (e.g., “I am also picking up on which terms are best to use when explaining the steps to solving problems.”).
- Teachers
  - Discussions of mentor teachers and interactions with them (e.g., agreement or disagreement with teaching styles, “Mr. [Teacher] is a very patient and thoughtful teacher.”).
- School
  - Positive descriptions and reactions to the host school (e.g., “This was an amazing school. I don’t know how else to phrase it. They work hard on building a community with their students and it shows.”).

#### Relation to Students

- Authority
  - Seeks to control or exert power over students (e.g., “We didn’t struggle with the students because in the past couple of weeks we have shown authority . . .”).
- Care
  - Seems concerned about students (e.g., “I hope the students feel as though they have improved and I hope that they feel less intimidated by math problems!”).

- Likes students
  - Likes or is interested in students (e.g., “One student today told me that he is going to college for Culinary Arts and he is going to different parts of the world to . . .”).
- Students like
  - Students like intern (e.g., “Many of them appreciate my help, and they want me to come watch their talent show.”).

#### Social Justice

- Compare
  - Comparisons of self to students at host school (e.g., “I went to a charter school when I was in high school, so I felt at home. It made me happy to see that the teachers were so thrilled to help the Latino community academically. The students reminded me a lot about myself. They made me want to come back and follow their footsteps to see in which university they end up in.”).
- High-need school
  - Working at high needs schools (e.g., “I have never had experience with urban, inner city schools prior to this, and I have truly learned so much.”).
- Underprivileged
  - Working with underprivileged students (e.g., “I learned about the very real barriers that these students face, including limited resources (e.g., there is no APCS class nor statistics class) as well as discouragement (e.g., [School] has a reputation for being a “rough school”; “the majority of students seem to struggle with motivation and confidence in their abilities”).

#### Teaching Difficulty

- Easier than expected (e.g., “I thought it would be a lot harder.”).
- Harder than expected (e.g., “Surprised at how hard it was.”).

#### Teaching Payoffs

- Teaching is frustrating (e.g., “I honestly cannot wait for this class to be over.”).
- Teaching is rewarding (e.g., “I knew I would enjoy it, but I did not know that I would look forward to each day like I do!”).