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Governance Brief

Creating and Maintaining a Pipeline for K-12 STEM Teachers in California

By Eric Hoyer

Introduction

California's K-12 teacher shortage is well known to school leaders. A 2018 CSBA survey of school human resources professionals found 76% of local educational agencies (LEAs) experienced teacher shortages, with at least half of LEAs short of math or science teachers.¹ Non-retirement attrition is one of the largest drivers of the current teacher shortage.² For those without a single subject credential in STEM (science, technology, engineering and math), turnover has proven to be high, between 25% and 30% in the 2015–16 and 2016–17 school years.³ Even for teachers with subject-appropriate credentials, turnover was at least 18% during this same period. Looking at the longer term, the pipeline of teacher candidates saw more than a 70% decline between 2002 and 2016.⁴ While there has been an uptick in the number of people preparing to become teachers since 2014–15, the number of potential teachers in the pipeline is less than half of prerecession levels.⁵ This shortage of teachers resulted in a surge of emergency waivers being issued by the California Commission on Teacher Credentialing (CTC), growing at a rate of more than 300% between 2014–15 and 2017–18, a trend that will likely continue.⁶

These shortages mean that students are less likely to be taught by a highly qualified teacher, and thus, less likely to succeed in STEM, pass their math and science courses, or choose careers with strong STEM components. Notably, California is projected to face a shortfall of more than one million qualified candidates for STEM-related jobs by the end of decade. The impact of these shortages disproportionately fall on high-needs schools.⁷ While some of the issues causing STEM teachers to leave the profession or not choose teaching are systemic of the teaching profession, another factor is

In this brief you will find:

- » The extent of the teacher shortage in STEM fields;
- » Past and present obstacles to building a stronger teacher workforce;
- » The roles of teacher preparation and credentialing in state efforts to reduce shortages;
- » Strategies states and LEAs are using to build their STEM teacher workforce; and
- » Areas of policy concern that affect STEM teacher recruitment and retention.

the plethora of job opportunities available to those with STEM backgrounds. Ironically, the demand for qualified STEM candidates is also driving current and would-be teachers away from the classroom.

This brief considers factors that are contributing to the overall teacher shortage, with special attention on the STEM fields. We will look at how efforts to build the teacher pipeline from college to credentialing are taking shape and what policy changes are needed to accelerate this change. Finally, we will consider steps school and state leaders can take to strengthen the STEM teacher pipeline immediately and in the future.

By the Numbers⁸

Quick Facts	
New Teachers	26% to 50% leave within five years
Teacher Turnover Costs	\$9 billion per year (nationally)

Top Reasons Teachers Leave	Key Finding for Leaving the Profession	Reasons Leaving Teachers Would Consider Returning
Inadequate Preparation of Novice Teachers	2.5x more likely	Salary (67%)
Lack of Support	2x more likely	Smaller class size (61%)
Challenging Working Conditions (e.g. lack principal support or time for teacher collaboration)	Often the top reason	Student loan forgiveness, housing incentives (25% each)
Compensation	Beginning teachers earn 19% less than their BA holding peers	Retirement program portability into and from other industries (68%)
Better Career Opportunities	1 in 4 teachers pursue other career options at the time of departure	Simpler recertification requirements; transfer certification between states (41% each)

A Brief History of California's Teacher Shortage

The shortage in K-12 teachers goes back to the mid-1980s. The CTC began issuing significantly more emergency teacher permits due to a growing workforce shortage. This rise in emergency permits was intended to be a temporary fix, but no significant changes were implemented to increase the teacher candidate pool. Another teacher shortage began in the late 1990s, and emergency permits were extended to almost 40,000 teachers. By end of the decade about 1 in 4 students were taught by teachers with emergency permits.⁹ While the emergency permit surge of the late 1990s did produce a significant amount of teachers who stayed in the profession, it also coincided with the period of time that the compensation gap between teachers and the average individual with a bachelor's degree started to widen.¹⁰ Since then, teacher preparation enrollment has declined to almost a quarter of what it was in 2002.

The housing shortage in many regions of California adds further pressure on LEAs that need to attract teachers to areas where the high cost of living makes recruitment more

difficult. Areas where STEM jobs are in demand are often the most expensive. For college graduates with a STEM background, the decision to go into teaching has become an increasingly expensive proposition. By the time STEM professionals hit mid-career, they earn on average 40% to 50% more than their teacher counterparts.¹¹

How STEM Teachers are Prepared in California

While the teacher pipeline can begin well before college, the undergraduate years are often where students choose their career path. For STEM majors, the coursework is rigorous and faculty often focus on training students to become practicing scientists. Accordingly, collegiate coursework in STEM subjects is designed around teaching research rather than the pedagogical skills required to become a teacher, such as presenting, lecturing, facilitating discussions, and stimulating critical thinking in others. Therefore, it is not surprising that there is often a lack of alignment between undergraduate math and science departments and teacher preparation programs. This disconnect impacts the quantity

of potential teachers because teaching is not promoted in the same way as commercial or academic research. It also bears on the quality of candidates who seek to become teachers as they are not as “classroom-ready” as their counterparts who majored in education.

One way to address this misalignment is to expand programs like UTeach, which gives undergraduate STEM majors the opportunity to earn a teaching credential while adding little or no time to obtaining their degree.¹² This nationally recognized program, spearheaded at the University of Texas at Austin (there are affiliate programs at University of California, Berkeley and UC Irvine), prepares students in rigorous science disciplines while also giving them the tools to succeed as teachers. As the California State University (CSU) system prepares most of California’s teachers, and the UC system increasingly few, it makes sense to expand this program or develop similar pathways at all CSUs. As a teacher preparation program is both an additional cost as well as an extra set of requirements, the state should be doing all it can do to make it easy for STEM majors to choose teaching as a career.

Students who do not participate in a combined bachelor’s degree and certification program like UTeach will have choices about which preparation path to take. Teacher preparation programs feature coursework on pedagogy, working with a mentor, and student teaching. Best practices tell us that programs featuring these three elements lead to better teacher retention. Traditional programs are better positioned to accomplish this as their programs are typically longer.¹³ While traditional programs prepare most candidates, alternative programs prepare more than 20% of candidates and their numbers are increasing. From 2014–15 to 2018–19, district and COE intern program enrollment has climbed by 80%.¹⁴ Alternative preparation programs vary in length and quality, but candidates are attracted to these options because they can be completed in less time, and the programs are generally less competitive for admission. In the case of LEA programs, candidates are often given financial support from those entities.

Total Enrollment and Completion in Teacher Preparation Programs 2017–18¹⁵

California State University System (CSU)	37.8%
University of California (UC)	3%
Private/Independent Colleges and Universities	55.2%
LEA Intern	4%

Teacher Preparation Enrollment by Type¹⁶

Type of Program	Population (2017–18)	Percent Change from Previous Year
Traditional	19,610	+2.5%
Alternative, IHE (Institute of Higher Education) approved	4,288	+11.2%
Alternative, non-IHE approved	1,056	+26.2%

Alternative programs can vary in quality, but Grow Your Own (GYO) programs and teacher residencies are two examples that have a record of teacher success and retention. GYO programs recruit local candidates who may not have considered teaching but are more likely to reflect local diversity and stay in the community. These candidates can receive support towards their undergraduate degree as well as their certification. An Urban Institute study of a national GYO program found that initial results were positive, with these teachers staying longer than an average novice teacher.¹⁷ For its part, California has had success recruiting diverse candidates with GYO programs such as the California School Paraprofessional Teacher Training Program (1995–2011) and the California Classified School Employee Teacher Credentialing Program (2016–present), the latter of which has provided \$45 million since 2016 to assist school staff to become teachers.¹⁸

Teacher residencies are postbaccalaureate programs that offer support for teacher certification programs and are reflective of a traditional program, albeit on an accelerated timeline. Modeled after medical residencies, prospective teachers typically receive a year of clinical (practice-based) experience alongside a mentor teacher, frequently including financial support in exchange for a three- to four-year teaching commitment.¹⁹ Graduates can often receive a master’s degree in addition to a credential. In turn, candidates commit to teaching in a high-needs area for several years. Research on these programs found that the teachers recruited demonstrate efficacy in the classroom as judged by their principals. These teachers are also more likely to be racially diverse (45% of candidates in a national study vs. 19% of teachers who enter the field) and more likely to stay in their high-needs district, compared to their peers who did not go through a similar alternative program.²⁰

Key Characteristics of Strong Residencies

Strong LEA and university partnerships
Coursework about teaching and learning tightly integrated with clinical practice
A full year of residency teaching alongside an expert mentor teacher
High-ability diverse candidates recruited to meet specific LEA hiring needs, typically in fields with shortages
Financial support for residents in exchange for a three-to-five-year post-residency teaching commitment
Cohorts of residents placed in partnership “teaching schools” that model good practices with diverse learners and are designed to help novices teach
Expert mentor teachers who co-teach with residents
Ongoing mentoring and support for graduates after they enter the teaching force

Adapted from the Learning Policy Institute²¹

Teacher Credentialing and the Role of the CTC

In California, the CTC requires that teachers complete additional requirements beyond the attainment of a bachelor's degree and the completion of an accredited preparation program. All candidates must pass a basic skills test, a course on the U.S. Constitution, and demonstrate subject matter competence through coursework or by exam. It is not uncommon for candidates to fail the basic skills test and/or the subject area test despite having completed all the other preparation.²² These exams are not just stumbling blocks to new candidates but for experienced out-of-state and private school teachers as well.

The California Legislature considered but did not pass three bills during the 2019–20 legislative session that would have waived teacher candidate testing requirements given the candidate completes the equivalent coursework, program, or another exam.^{23, 24, 25} [Assembly Bill 2485](#) (Kalra) would have let candidates waive the California Subject Examinations for Teachers (CSET), which has passage rates of less than 60% in math and science. The passage rates for African American candidates is as low as 29% for the science exam.²⁶ [AB 1982](#) (Cunningham) proposed to allow waivers for the Basic Skills Test (CBEST), if candidates achieve a B or higher in their teacher preparation program. For those

seeking a multiple subject credential, the required Reading Instruction Competence Assessment (RICA), is another test that has a high failure rate. [Senate Bill 614](#) (Rubio) proposed elimination of the RICA. Although this bill did not succeed, efforts to replace the RICA continue.²⁷

Strategies to Improve Teacher Recruitment and Retention

Recruiting and retaining high-quality STEM teachers requires collaboration between LEAs, colleges and universities, state agencies, and policymakers. There are several areas that can improve teacher recruitment and retention, according to research and advocates.

Salaries. There have been recent national efforts to raise teacher pay. Some 2020 presidential candidates made this a feature of their platforms. As the market for STEM degrees lures graduates away from teaching, more will need to be done to increase the pool of math and science teachers. Few LEAs in California have made specific STEM bonuses a part of their compensation package. One of the potential barriers to offering STEM teachers differential pay is collective bargaining agreements (CBAs) with labor unions. Even the most affluent LEAs are limited in what they can offer STEM teachers, especially new teachers who are already more prone to leaving the profession. One lever that can be used for high-poverty schools is Every Student Succeeds Act (ESSA) Title II-A funding. These monies can be used for a broad range of efforts, including differential pay and funding teacher residencies and induction programs. This funding requires schools to address equity gaps and support STEM teachers, who are particularly hard to attract and retain in high-need schools. Having “ineffective,” “out-of-field,” or “inexperienced” teachers is a form of inequity that can be addressed by targeting these funds.²⁸

Loan forgiveness. One barrier to teacher preparation is cost. The average college student with a bachelor's degree in California graduates with \$20,000 in debt.²⁹ A teacher preparation program can add over \$10,000 to this cost with an additional \$5,000 required to obtain a teaching credential.³⁰ LEAs can offer compensation to support induction, but more can be done on the front end of the pipeline to increase the teacher pool. North and South Carolina have had a great deal of success with their teaching fellows programs, retaining over 70% of program graduates in the teaching field after five years. The programs offer college scholarships as well as support towards a credential in exchange for a teaching commitment of four years. The North Carolina program trained close to 10% of all

teachers in the state and its retention rate exceeded that of all other preparation paths.³¹

Retired teachers. Retired teachers are an important resource to expand the teaching pool. Retired teachers are an immediate source of experienced labor. One hindrance to expanding this strategy in California is the earnings cap on retired teachers. For 2020–21, a retired teacher can earn \$47,713 per year without negatively affecting their CalSTRS pension.³² Raising the cap would entice more teachers to return to the classroom. As of 2020, the average retirement age for CalSTRS member was 61.5 years, making potential additional service years not insubstantial.³³

Mentoring pay and career ladders. Retired and experienced teachers are often tapped to mentor novice teachers, providing valuable experience that is associated with greater retention of newer teachers.³⁴ One of the difficulties in keeping experienced mentors is that experienced teachers often seek out and are encouraged to take school leadership roles, in part because of the higher compensation. Offering pay for mentoring to keep experienced teachers in the classroom can be a valuable instrument for retention. As with STEM differentials, bargaining contracts may need to be revisited in order to allow an LEA to offer these supplements. Along the same lines, LEAs may want to consider developing mentoring positions, similar to the role of a Teacher on Special Assignment (TOSA), but on a more permanent basis. These kinds of positions would provide incentives to go into mentoring. Career ladder models—such as those used in Rochester, NY, and Cincinnati, OH—are one example of this, with progressions of responsibilities such as intern, resident, traditional classroom teacher, and a lead teacher who also assumes instructional coaching responsibilities.³⁵ Both programs feature increased teacher responsibility and compensation and can be funded from ESSA Title II-A funds.

Professional and Career Development

Professional development and administrative support are also important in attracting and retaining qualified teachers. A key research finding is that supporting induction experiences are crucial to keeping novice teachers in the profession. At least 26% of teachers leave the profession in the first five years, which is both a tremendous loss to the school and to the investments of the state.³⁶ Supporting induction to a clear credential, with solid mentoring experiences, will aid in teacher retention.

Essential to supporting and retaining teachers is providing good leadership, which inspires confidence. Principals shape their school culture, assign workloads, assist

teachers with paperwork, and provide time and funds for professional development. Research has shown that principals are crucial to both teacher retention and satisfaction.³⁷ In the context of NGSS, principal support is crucial to teachers' ability to apply new curriculum in the classroom without fear of failure. In order to do this, principals must feel confidence in the curricula itself, especially in Common Core Mathematics and NGSS, which requires professional development. As many LEAs move to adopt NGSS materials in the next few years, school administrators must have a basic competence in the subject area to support teachers who are making the shift to the new science standards.

STEM residency. Supporting teacher residency programs is another way to develop the capacity of novice teachers while giving them a strong incentive to stay in the district for three to five years. California, Indiana, and Minnesota have all developed STEM teacher residencies. In California, the Los Angeles Unified School District and Bakersfield USD have developed residency programs in concert with their local CSU campuses (Dominguez Hills and Bakersfield, respectively) that received federal grants to develop STEM teacher training. CSU Dominguez Hills' program, STEM Teacher in Advanced Residency (STAR), offers candidates the ability to obtain a single subject credential and a master's degree in 15 months. Candidates participate in a semester-long internship with a mentor. The program is geared toward recent STEM college graduates and mid-career professionals. Candidates receive a \$30,000 stipend as well as a \$4,000 grant to support them as they complete the program. The Bakersfield program concentrates on elementary STEM and has partnered with three rural districts to offer similar support and guidance to candidates. One district has been able to retain 95% of their graduates after 3.5 years.³⁸

Conclusion

In this brief, we outlined some of the systemic issues contributing to teacher shortages, as well as factors that pertain particularly to STEM. We also examined some potential policy changes at the state and local level that can make short- and long-term progress in closing the shortage gap. As California faces a deep economic downturn that, by one estimate, threatens over 50,000 teaching positions, it is imperative that state policymakers and LEAs use as many strategies in their toolkit as possible to recruit and retain STEM teachers and mark their priorities as they make decisions that will impact schools for years to come.³⁹

Questions for Board Members

1. What has your LEA done in the past five years to recruit more STEM teachers? What has been effective? What kinds of compensation incentives are allowable in your current CBA? What conversations have you had with your bargaining unit leadership about the need for more STEM teachers?
2. Where do your teachers get prepared? What kinds of conversations might you have with faculty about candidates' classroom-readiness or attrition?
3. What is your local CSU doing to prepare STEM teachers? Do faculty have grants to expand STEM access? Is it possible to develop residencies oriented towards STEM either with the CSU or other regional provider?
4. How do you use retired teachers in your LEA? How many are in the STEM fields? Do they provide mentoring?
5. What kinds of survey data do you have about teacher attrition? Are the reasons in line with those presented here?
6. What actions is your LEA taking—or planning to take—to ensure your school principals are adequately prepared to support and retain new teachers?

Resources

Cal State University Dominguez Hills STEM Residency <https://www.csudh.edu/csi3/star/>

Cal State University, Bakersfield STEM Residency <https://bit.ly/3e71Rhu>

Kern Rural Teacher Residency <https://bit.ly/2UPHa1T>

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Endnotes

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