How might we ensure teachers enter the classroom well-prepared to teach STEM?

MANY TEACHER PREPARATION PROGRAMS DO NOT ACCOUNT FOR LOCAL OR REGIONAL NEEDS.

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01 CONTEXT AND TRENDS

Local teacher shortages abound, according to recent reports, particularly with respect to finding qualified and well-prepared teachers in specific subjects. Even more concerning, however, is that many of these shortages persist in subjects recognized as critical to students' preparation for the jobs of the future—science, technology, engineering, and math (STEM; Sutcher, Darling-Hammond, & Carver-Thomas, 2016; Cowan, Goldhaber, Hayes, & Theobald, 2016). The cause of this crisis is more nuanced than just a need to produce more teacher prep program graduates overall. A closer look at the data reveals that the scarcity of STEM teachers is largely a local issue, the result of an imbalance between the supply and demand of teachers in specific subjects available for hire in specific schools.

Some schools have an ample supply of qualified STEM teachers, while others struggle for years to fill open positions with teachers who come to the classroom with strong STEM training. The wide variations in shortages that exist across communities and classrooms result from myriad local factors, the interplay of which differentially affect some states, subject areas, and student populations more than others (Sutcher et al., 2016). These labor market influencers include working conditions, teacher salaries and incentives, and teacher attrition rates, the data for which often tell a different story at each level in the system. For example, Sutcher et al. (2016) explain, "even though the teacher labor market might be balanced at the state level, subjects or regions within the state may be experiencing shortages. These disparities within and across education systems, which are related to policy differences at each level, create very different labor markets from one state, and even one district, to another" (para. 10).

Certainly, growing the overall pool of excellent STEM teachers at the national level is important given stagnant trends in teacher production in these subjects. A local focus, however, may better ensure equity in the system. For example, teacher preparation programs and local schools or regional districts can create strategic collaborations to help determine

what types of teachers are needed in terms of content and skills and what kind of preservice training would best prepare candidates. In addition, the development of robust and accurate tracking systems that assess and forecast supply and demand for STEM teachers in local jurisdictions can facilitate more direct pathways for newly minted teachers into high-demand positions for which they have been specifically prepared.

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DISCUSSION

According to an Education First (2016) report, "In an era of rigorous college- and career-ready standards, increasingly diverse student backgrounds, and tougher educator evaluation systems, novice teachers are entering classrooms that require new and higher levels of expertise and instruction" (p. 1). Teacher preparation programs are largely failing to keep pace with the rapidly changing environment and requirements of today's teaching workforce, including the need for all PK–12 teachers to be prepared to provide or integrate STEM instruction. STEM teacher production, for example, has remained relatively flat despite the local and national prioritization of expanding student access to and improving quality of instruction in these critical fields (Startz, 2015). In emerging high-demand STEM subjects like computer science, which is now listed as a core academic subject, very few teachers have official computer science (CS) credentials. Projections estimate a need for more than 30,000 teachers qualified to teach CS at the secondary level by 2025 (Kosturko, 2016). If the current rate of teachers receiving training in CS remains the same, we're likely to face a shortage of about 23,000 CS teachers (Kosturko, 2016). This mismatch between the skills of graduating preservice teachers and the needs of districts and schools leaves many district leaders facing "the prospect of not being able to put anyone, much less a high-quality teacher, in front of each student on the first day of school" (Education First, 2016, p. 1).

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Policies and incentives that support collaborative and mutually beneficial partnerships between districts (the "consumers") and local colleges, universities, and other prep programs (the "suppliers") can help solve the teacher shortage issue. For these relationships to work, however, the traditional drivers influencing prep program design and delivery need to be reversed. Namely, "the needs of consumers—including teacher candidates, districts, and K–12 students—should be the driving consideration in decisions about the structure and content of teacher preparation," rather than state compliance requirements and the needs and norms of higher education institutions (Mead, Aldeman, Chuong, & Obbard, 2015, p. 28).

For example, for decades, teacher prep programs have set their own enrollment targets without any accountability or regard for satisfying local district and school needs (Walsh, 2016). A revised and collaborative approach would require teacher prep programs to work with their local districts and schools to set enrollment targets based on the specific needs and contexts of those districts and schools.

While this type of intentional collaboration must take place between preparation programs and local districts to reduce the imbalance between the supply and demand of STEM teachers, it must also be supplemented by the development and effective leveraging of robust and accurate tracking systems to forecast accurate numbers of STEM teacher vacancies. Over the past 10 years, however, only about half of the U.S. states have produced detailed teacher supply-and-demand reports (Aragon, 2016; Behrstock-Sherratt, 2016). In 2009, the Regional Education Laboratory Midwest at the American Institutes for Research conducted a study to examine the methodologies seven states used for tracking educator supply and demand data. Findings from the report demonstrate that states used a wide range of calculations to assess their needs. For example, two states used only a single indicator of teacher shortage, three states gathered data from multiple sources beyond state administrative data to glean deeper insight into the context of the issue, and two states went beyond reporting past trends to projecting future teacher demand (Behrstock-Sherratt, 2016).

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While these efforts indicate some strides in the right direction, there is considerable room to improve these data systems to track and accurately forecast educator supply and demand. However, states and teacher prep programs do face a number of challenges in the process of developing these data systems, including incomplete or inconsistent data, an inability to maximize the full potential of the data, insufficient resources necessary to continually collect and update data overtime, and lack of consensus in the education field on exactly what data should be used to track educator supply and demand (Allen, 2010; Behrstock-Sherratt, 2016). Despite these challenges, the need to initiate, improve, and collaborate using these data tracking systems is necessary if we hope to offset the imbalance in teacher supply and demand. Fortunately, some states and districts are leading the way.

03 BRIGHT SPOTS

District and prep program partnerships are not just a "pie in the sky" idea. Tangible efforts are playing out in local jurisdictions, and Education First is supporting the movement through its Roadmap for District and Teacher Preparation Programs to Build and Sustain Strong, Bold Partnerships. This roadmap includes 10 recommendations divided across three stages of partnership-building for district and prep program collaborations that result in effective teacher pipelines. Two early-phase recommendations are 1) districts gaining an understanding and sharing their talent pipeline needs with teacher prep programs, and 2) district and prep programs working together to develop aligned rubrics and key expectations for program graduates. A later-phase recommendation is the partners jointly selecting and training mentor teachers and strategically placing candidates.

One example of a burgeoning partnership is between the Fresno Teacher Residency Program and the Fresno Unified School District (FUSD) in Fresno, California, which has

historically struggled to improve student achievement in STEM subjects and hire effective teachers who reflect the racial and ethnic backgrounds of its majority-Hispanic student population. Drawing on the support of the Bechtel Foundation and a federal Teacher Quality Partnership Grant, the program has a focus on preparing STEM teachers from underrepresented groups who commit to teaching in FUSD schools (Mead et al., 2015).

As another example, the near 20-year partnership among the Long Beach Unified School District (LBUSD), California State University Long Beach and Long Beach City College has reformed teacher preparation using a model that includes ongoing dialogue about what new teachers need to know and what kinds of experiences and coursework (including integrated approaches to STEM teaching and learning) will develop that knowledge. College of Education faculty members as well as LBUSD administrators teach preservice courses, and some courses are even offered on district school campuses, while teacher candidates complete field experiences in the district's diverse classrooms (Mead et al., 2015; Education First, 2016).

Tangible efforts are also underway to predict and prevent teacher shortages in different states throughout the U.S. For example, the Missouri Educator Shortage Predictor Tool is currently being developed by the Missouri Department of Elementary and Secondary Education (DESE) Office of Educator Quality with support from the Central Comprehensive Center at the University of Oklahoma, the Regional Educational Laboratory Central, and the Center on Great Teachers and Leaders. Using the precision of this statistical model, the Missouri DESE plans to more effectively collect, analyze, and communicate educator supply and demand data to better inform districts, prospective educators, and teacher prep programs on where shortages persist and job openings exist across the state. Results from the Shortage Predictor Model in 2015, for example, identified a sharp decline in the shortage of high school science teachers in northeast Missouri, a steady decline of high school science teachers in St. Louis, and a "distressingly high" shortage of high school science teachers in southwest Missouri (Palmer, 2015), information that helped to guide both teacher preparation programs to more strategic admissions decisions and states to deploy their best teachers where they are needed most. Arkansas and Louisiana have developed similar educator predictor models.

Using an externally contracted approach, Massachusetts commissioned 10-year projections of teacher supply and demand to determine and prepare for future workforce needs. To calculate these projections, the American Institutes for Research collaborated with the Massachusetts Department of Elementary and Secondary Education Office of Planning and Research, as well as the Center for Educator Effectiveness, to define key research questions. Then, by drawing data from publicly available databases, the researchers calculated aggregate projections of annual supply and demand, as well as detailed supply and demand projections by program area, region, and teacher demographic groups (Levin, Berg-Jacobson, Atchison, Lee, & Vontsolos, 2015).

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CONCLUSION

It is crucial that we address the STEM teacher shortages challenge for the benefit of our students and the future of our nation, and that we take an effective, long-term approach in doing so. The current imbalances and inequalities in the production and placement of PK–12 teachers who are well prepared to provide students with engaging STEM learning experiences, while concerning, also present us with an opportunity—namely, to develop better data tracking systems and restructure the traditional modes in which preparation programs, states, and local districts and schools have operated. We can break down the silos that have prevented data-sharing and dynamic collaborations across these entities to create innovative partnerships—partnerships that redefine the relationships, roles, and responsibilities these parties have in the preparation, training, and placement of future generations of teachers who come to the classroom ready to provide the instructional experiences students need to succeed.

ABOUT THE GRAND CHALLENGES WHITE PAPERS

In 2017, 100Kin10 released an unprecedented representation of the big, systemic challenges to preparing and supporting STEM teachers following over two years of extensive research alongside more than 1,500 STEM teachers and hundreds of other education experts. As a part of this work, 100Kin10 commissioned a series of short white papers from well-versed thinkers and practice-oriented researchers to synthesize the most relevant research around the specific challenge areas. Together, they compose a thoughtful and well-rounded examination of the systemic challenges currently facing STEM teaching.

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