POLICY BRIEF

Analyzing the Effects of the Noyce Program on STEM Teacher Placement and Retention in Highest-Need Schools

By Toni Templeton, Chaunté White, Michelle Tran, Sherri Lowrey, and Catherine L. Horn, University of Houston

Executive Summary

To mitigate the national teacher shortage (Sutcher et al., 2016), the National Science Foundation (NSF) created the Robert Noyce Teacher Scholarship Program in 2002 (NSF, 2017; U.S. Department of Education, 2015) to encourage students seeking degrees in the fields of science, technology, engineering, and math (STEM) to become STEM teachers. Specifically targeted at schools with a high need, the program provides stipends to STEM majors in exchange for their service teaching in schools with a high percentage of students from low-income families, a high percentage of educators teaching outside their certification area, or high teacher turnover rates. Despite the program's intended purpose of increasing the pipeline of STEM teachers to high-need schools, this research found that the program's definitions of high need do not create the distinction necessary for change in a state like Texas. Since the program's inception 20 years ago, Texas institutions have implemented more than 30 Noyce programs across the state (Center for Research, Evaluation, and Advancement of Teacher Education, 2015; NSF, 2017). However, because the state's public school population is composed of 60% low-income students, defining schools as high need based upon a district standard of at least 50% low-income students makes almost every school in the state eligible for Noyce scholars. This has rendered the Noyce program largely ineffective at increasing the number of STEM teachers in Texas schools with the highest need.

KEY TAKEAWAYS

- **Noyce participation** was found to have no significant relationship to the likelihood of STEM teachers being placed in highest-need schools.

- **To increase high-quality STEM teachers** in schools of highest need, national programs should consider the local student demographics.

POLICY BRIEF

Purpose of the Study

The United States faces persistent shortages of STEM educators in high-need fields such as chemistry, physics, and computer science, creating what researchers have described as an impending crisis with the potential to drastically impact the nation's capacity to increase mathematics and science literacy and advance technological innovation (Sutcher et al., 2016). Such trends are especially visible at campuses with higher economic needs (Yang, 2015). During the 2015–2016 school year, more than 40 states, including Texas, reported teacher shortages in mathematics and science. The purpose of this study is to investigate the effectiveness of the NSF's Robert Noyce Teacher Scholarship Program as a means of increasing the placement and retention of STEM teachers into the highest-need schools in Texas, a state where the public school student population is majority low-income.

The Robert Noyce Teacher Scholarship Program

To increase the number of STEM teachers and improve their retention—specifically in schools with high need—the NSF created the Noyce program, which encourages STEM students and professionals to pursue teaching. In exchange for a commitment to teach in a high-need school for at least two years post-graduation, students pursuing STEM majors gain access to scholarships, teacher preparation support, and internship opportunities aimed at facilitating their path toward becoming STEM educators (NSF, 2017). Historically, the Noyce program has been found to have modest influence on the placement of STEM teachers in high-need schools (e.g., Ticknor et al., 2017) and has not demonstrated success at increasing the retention of those teachers in high-needs schools beyond the two-year commitment (Liou et al., 2010). Noyce scholars who successfully transitioned into and remained teaching in high-needs schools often cited the program's faculty and peer support systems, the development of their own positive self-view of themselves as STEM teachers, and financial support as critical success factors (e.g., Morrell & Salomone, 2017).

40+

The number of states, including Texas, that reported teacher shortages in mathematics and science during the 2015–2016 school year.

Background in STEM Teacher Recruitment and Retention

The persistent teacher shortages in schools are exacerbated for STEM teachers by the unique challenges of recruitment and retention within the STEM community. The deep content and pedagogical knowledge necessary to teach STEM courses narrow the field of candidates (Hough, 2000), and STEM teacher recruitment is hindered by a lack of awareness and understanding of teacher certification programs (Darling-Hammond & McLaughlin, 1995; Hutchison, 2012; Ingersoll & Smith, 2003). Beyond the struggles of recruitment, STEM teachers are also retained at lower rates than teachers in other content areas. While there are some factors contributing to teacher retention common across subject areas, including job satisfaction, age, and leadership, STEM teacher retention is distinctively affected by dissatisfaction with the lack of autonomy that has accompanied the high-stakes testing environment of the 21st century and the unlikeliness of encountering school leadership with a background in STEM (Suárez & Wright, 2019). In addition, it has been suggested that STEM teachers' focus on content delivery could take attention away from classroom management and lead to increased struggles with student behavior (Wang et al., 2018). Such factors contribute to decreased STEM teacher retention, which compounds the STEM teacher shortage problem.

Data & Methods

The data for this project primarily derive from the

Because 70% of campuses in Texas serve a student body that is at least 70% low-income students, we defined highest need as schools serving at least 75% low-income students to account for the large population of low-income students in the state.

University of Houston Education Research Center's state-level administrative data repository of teacher preparation, certification, and teaching. These data were combined with information from the four participating universities, which identified 167 Noyce program participants enrolled between 2010 and 2018. The data set included information on teacher preparation, certification, school placement, and students and courses taught. The 167 Noyce participants were compared with 781 other teachers who were not Noyce participants, attended teacher preparation programs at one of the four participating institutions, and taught at least one middle school or high school STEM course for one school year.

For this study, we were interested in STEM teacher placement and retention at the highest-need schools. Because 70% of campuses in Texas serve a student body that is at least 70% low-income students, we defined highest need as schools serving at least 75% low-income students to account for the large population of low-income students in the state. Controlling for the differences among teachers in the state, we used logistic regression modeling to determine the degree to which Noyce program participation was related to teacher placement and retention at the schools with highest need.

Results

Recruitment. In their first year of teaching, 353 (37%) of the total 948 teachers in the data set were hired by campuses with at least 75% low-income students—34% of Noyce participants and 38% of non-Noyce participants. After controlling for differences among teachers, we found Noyce participation to have no significant relationship to the likelihood of STEM teachers being placed in highest-need schools. The likelihood of STEM teachers being recruited to highest-need schools was significantly related to the race and ethnicity of the teacher and the grade levels served by the school. Teachers identifying as African American were almost four times as likely as teachers from other racial/ethnic groups to be recruited to the highest-need schools. Teachers identifying as Hispanic were more than twice as likely as teachers from other racial/ethnic groups to be recruited to the highest-need schools. Teachers placed in high schools were about half as likely to teach at the schools of highest need compared with teachers placed in middle schools or other grade level configurations (excluding elementary school).

Retention. Of the 948 first-year teachers in the data set, 85% remained teachers in their second year, and 72% of the 353 teachers who taught their first year at a highest-need school remained in a teaching role at a highest-need school in their second year. Of the teachers placed in highest-need schools, Noyce recipient teachers had a 64% retention rate and non-Noyce recipient teachers had a 73% retention rate. From the data set of STEM teachers placed in highest-need schools, the likelihood of retention at highest-need schools was significantly related to the certification area of the teacher. Those teachers certified in mathematics or science were half as likely to remain teachers at the schools of highest need compared with teachers certified in other areas. Due to the small subset of teachers who remained in highest-need schools, additional research in this area is needed.

Discussion & Conclusion

This study examined the ways in which the Robert

Noyce Teacher Scholarship Program—which was designed by the NSF to increase STEM teachers in high-needs schools—increased the placement and retention of such teachers in Texas. The widespread distribution and high numbers of economically disadvantaged students across the state have created a situation where most districts qualify as high-need according to the Noyce program definition. By examining the placement of students in only the highest-need schools across Texas (those with 75% or more economically disadvantaged students), we determined that the Noyce program did not significantly increase placement or retention of STEM teachers at high-need schools.

Consideration of local context is also critical to redefining what qualifies as "highest need" in Noyce program requirements. The criteria that educators must teach in schools serving a student population that is composed of at least 50% economically disadvantaged students may need to be adjusted to better tailor the program to the needs of a state like Texas. For maximum impact, the Noyce program should consider changing its criteria for highest-need schools to reflect local context.

Exploration of the influence of racial and eth-

We found Noyce participation to have no significant relationship to the likelihood of STEM teachers being placed in highest-need schools.

nic congruence among teachers and students in STEM teacher placement and retention is also necessary. Prior research shows that minority teachers are likely to stay in high-need schools (Podolsky et al., 2019) and minority students benefit from having a teacher of their own race and ethnicity (Egalite et al., 2015). Given available literature identifying the benefits of Noyce financial support (Evans et al., 2019), such targeted efforts may not only increase the retention of STEM teachers in high-need schools but also may help reduce the financial disparities that students of color in the teacher pipeline experience regarding college affordability. Continued work exploring the myriad positive impacts of Noyce remains important.

POLICY BRIEF

References

Center for Research, Evaluation, and Advancement of Teacher Education. (2015). *Analysis for colleges of education consortium-wide report. Unpublished report to the vice-chancellors of UT, Texas A&M, University of North Texas and University of Houston Systems.* TX.

Darling-Hammond, L., & McLaughlin, M. W. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan, 76*(8), 597–604.

Egalite, A. J., Kisida, B., & Winters, M. A. (2015). Representation in the classroom: The effect of own-race teachers on student achievement. *Economics of Education Review, 45,* 44–52.

Evans, P. K., Dillard, K. C., Rodriguez-Wilhelm, D., & McAlister-Shields, L. (2019). Like-minded people: University-based interdisciplinary collaborations in STEM teacher preparation programs. *Journal for STEM Education Research, 2*(1), 35–54.

Hough, D. (2000). *Teacher supply and demand in Missouri, 1999–2000.* Springfield: Southwest Missouri State University.

Hutchison, L. F. (2012). Addressing the STEM teacher shortage in American schools: Ways to recruit and retain effective STEM teachers. *Action in Teacher Education, 34*(5-6), 541–550.

Ingersoll, R. M., & Smith, T. M. (2003). The wrong solution to the teacher shortage. *Educational Leadership, 60*(8), 30–33.

Liou, P.-Y., Kirchhoff, A., & Lawrenz, F. (2010). Perceived effects of scholarships on STEM majors' commitment to teaching in high need schools. *Journal of Science Teacher Education, 21*(4), 451–470.

Morrell, P. D., & Salomone, S. (2017). Impact of a Robert Noyce Scholarship on STEM teacher recruitment. *Journal of College Science Teaching, 47*(2), 16–21.

National Science Foundation. (2017). Robert Noyce Teacher Scholarship Program. Program Solicitation. Retrieved April 28, 2020, from https://www.nsf.gov/pubs/2017/nsf17541/nsf17541.htm

Podolsky, A., Kini, T., Darling-Hammond, L., & Bishop, J. (2019). Strategies for attracting and retaining educators: What does the evidence say? *Education Policy Analysis Archives, 27*(38).

Suárez, M. I., & Wright, K. B. (2019). Investigating school climate and school leadership factors that impact secondary STEM teacher retention. *Journal for STEM Education Research, 2*(1), 55–74.

Sutcher, L., Darling-Hammond, L., & Carver-Thomas, D. (2016). *A coming crisis in teaching? Teacher supply, demand, and shortages in the U.S.* Learning Policy Institute. https://edworkingpapers.com/sites/default/files/A_Coming_Crisis_in_Teaching_REPORT.pdf

Ticknor, C. S., Gober, D., Howard, T., Shaw, K., & Mathis, L. A. (2017). The influence of the CSU Robert Noyce Teacher Scholarship Program on undergraduates' teaching plans. *Georgia Educational Researcher, 14*(1), 3. https://digitalcommons.georgiasouthern.edu/gerjournal/vol14/iss1/3

U.S. Department of Education. (2015). *Teacher shortage areas nationwide listing: 1990–1991 through 2015–2016.* Washington, DC.

Wang, K., Chen, Z., Luo, W., Li, Y., & Waxman, H. (2018). Examining the differences between the job satisfaction of STEM and non-STEM novice teachers with leaving intentions. *EURASIA Journal of Mathematics, Science and Technology Education, 14*(6), 2329–2341.

Yang, J. (2015). Discovering the needs assessment of qualified STEM teachers for the high-need schools in South Texas. *Journal of STEM Education, 16*(4).