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POLICY BRIEF

Associations Between Predictive Indicators and Postsecondary Science, Technology, Engineering, and Math Success Among Hispanic Students in Texas

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What We Studied

Hispanic students continue to be underrepresented among employees in the fields of science, technology, engineering, and math (STEM) in the United States. In 2009, Hispanic employees accounted for 14 percent of the workforce but held only 6 percent of STEM jobs (Beede et al., 2011). This discrepancy is a concern in light of the fact that the number of jobs in the STEM sector is projected to grow substantially (Vilorio, 2014) and that jobs in STEM fields command wages that are, on average, 26 percent higher than those in non-STEM fields (Langdon et al., 2011). Moreover, the wage difference between STEM work and non-STEM work is larger for Hispanics than for non-Hispanic Whites (Beede et al., 2011), and data on the pipeline of STEM majors indicates that the discrepancy in employment is likely to persist. Hispanic students received 9.2 percent of science and engineering bachelor's degrees in 2012/13, even though they constituted 10.5 percent of all bachelor's degrees conferred that year (Ginder, Kelly-Reid, & Mann, 2014; National Center for Education Statistics, 2016). Among students who decide to major in a postsecondary STEM field, Hispanic students persist at lower rates than non-Hispanic White students (Higher Education Research Institute, 2010). Concern about underrepresentation of Hispanic individuals in STEM majors and fields is particularly acute in Texas, where Hispanic students represent 51 percent of the K–12 student body.

The Texas Hispanic STEM Research Alliance, comprised of individuals who work in school districts, state education agencies and resource centers, and institutions of higher education across the state, partnered with the Regional Educational Laboratory Southwest on a series of investigations to identify indicators of STEM-related postsecondary outcomes specifically for Hispanic students in Texas. Identifying academic indicators that may differ specifically for Hispanic students relative to other racial/ethnic groups could help educators and policymakers understand the reasons for lower levels of attaining STEM postsecondary outcomes among Hispanic students. The study addresses the following research questions:

1. Which high school academic indicators predict whether Texas high school graduates will enroll, persist, or complete a degree in a STEM field?
2. Do high school academic indicators of postsecondary outcomes function differently for Hispanic students (of any racial group) than for non-Hispanic White students?

The present study examined the relationship between postsecondary STEM success and the following indicators, most of which are related to student academic experiences and performance in math and science:

- Number of math or science classes taken in high school.
- Highest level of math or science class taken in high school.
- Number of math or science Advanced Placement (AP) classes taken in high school.

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- SAT composite score (sum of math and verbal subtest scores).[1]
- State assessment scores in math and science from grades 10 and 11.
- High school attendance rate.

The outcomes of interest were three binary (yes or no) measures of postsecondary success in STEM:

- **Declaring a STEM major:** whether a college student ever declared a STEM major.
- **Persisting in a STEM major:** whether a college student who declared a STEM major remained enrolled as a STEM major for all subsequent semesters.[2]
- **Completing a degree in a STEM field:** outcome to indicate whether a college student completed a degree (even from a different institution of higher education than at first enrollment) and the most recent major listed was a STEM major.[3]

How We Analyzed the Data

Data source. All K–12 student academic data was provided by the Texas Education Agency. College enrollment data for Texas public high school students who enrolled in colleges and universities in Texas was provided by the Texas Higher Education Coordinating Board.

Study sample. The study comprised seven cohorts of Texas high school students who began Grade 9 from 2000 to 2006 and who were enrolled in a Texas high school for their entire high school experience, or moved into a Texas high school after Grade 9 and joined one of those cohorts (and were enrolled in a Texas public high school for at least three years). The study sample was also limited to the subset of these students that enrolled in a Texas college by the spring of 2011; this represented 54 percent of all Texas public high school graduates from these cohorts. These students were split into two separate samples corresponding to students initially enrolling in two-year colleges (the two-year sample) and four-year colleges (the four-year sample). Some research questions could be examined with only a subset of the seven cohorts based on data availability. For example, data on completing a degree from a four-year college were available only for Cohorts 1–4. Furthermore, data on declaring and persisting in STEM majors were not available from students enrolled in four-year private institutions of higher education.

Data analysis procedures. Research Question 1 was addressed using regression models that examined relationships between possible indicators (for example, number of math or science classes taken, math or science assessment scores) with the outcomes of interest (declaring a STEM major, persisting in a STEM major, and completing a STEM degree), while controlling for nonmalleable student and school factors (such as sex, race/ethnicity, English learner status, and percentage of English learner students in the student's high school) as well as for cohort fixed effects. Research Question 2 was addressed by adding interaction terms to the regression model. These interaction terms provided a separate estimate, for Hispanic, non-Hispanic Black, non-Hispanic White, and Other ethnicity students, of the association of each indicator with each postsecondary outcome. These analyses sought to identify those indicators shown to be associated with postsecondary outcomes under Research Question 1 that performed differently for Hispanic students relative to non-Hispanic White students.

What We Discovered

Research Question 1: What are the Indicators of Post-Secondary STEM Outcomes?

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[1] The Texas Education Agency's data system provided only the composite score, not the subtest scores.

[2] Students who never declared a STEM major were excluded from this analysis.

[3] For students composing the two-year institution of higher education (IHE) sample, analyses examined whether students completed a two-year or a four-year STEM degree. For students composing the four-year IHE sample, analyses examined whether students completed a four-year STEM degree (regardless of whether they previously or subsequently completed a two-year STEM degree).

Findings were related to three types of indicators: advanced course taking, standardized assessment scores, and attendance.

Advanced course taking

- Among students enrolled in two-year colleges, taking higher-level math or science courses predicted better post-secondary STEM outcomes of all types. Taking more Advanced Placement science courses predicted higher rates of declaring a STEM major, and taking more science courses overall predicted higher rates of completing a STEM degree.
- Among students who enrolled in a four-year college, taking an Advanced Placement calculus course and taking Advanced Placement Physics predicted higher rates of persisting in a STEM major. Taking more math and science courses predicted higher rates of persisting in a STEM major, and taking more Advanced Placement math courses predicted higher rates of completing a STEM degree.

Standardized assessment scores

- Among students who enrolled in a two-year college, higher grade 11 state assessment scores in math and science predicted higher rates of declaring and persisting in a STEM major and completing a STEM degree.
- Among students who enrolled in a four-year college, a higher grade 10 state assessment score in science predicted higher rates of persisting in a STEM major, and a higher grade 11 score predicted higher rates of completing a STEM degree.

Attendance

- High school attendance was associated with a greater likelihood of declaring a STEM major and completing a STEM degree among students who enrolled in a two-year college and with a greater likelihood of persisting in a STEM major among students who enrolled in a four-year college.

Research Question 2: Do Indicators of Post-Secondary Outcomes Differ for Hispanic Students?

- No indicators of post-secondary outcomes were predictive only for Hispanic students, and most indicators functioned similarly for Hispanic and non-Hispanic White students.
- Among students who enrolled in a two-year college, the grade 11 state assessment score in science was less strongly associated with the likelihood of declaring a STEM major for Hispanic students than for non-Hispanic White students.
- Supplementary analyses demonstrated that the indicators differed by student sex. Among students who enrolled in a two-year college, taking high-level math courses and scoring higher on state assessments in math much more strongly predicted declaring a STEM major for males than for females.

Policy Recommendations/Implications

This study demonstrates that Hispanic students reap the same benefits of taking higher level math and science courses in high school as non-Hispanic White students do in terms of postsecondary STEM outcomes. Among students who enrolled in a two-year college and students who enrolled in a four-year college, Hispanic students took fewer math and science courses overall, and took less rigorous courses, than non-Hispanic White students did. However, when indicators of academic experiences and achievement in math and science in high school were held constant, the likelihood of postsecondary STEM success did not differ between Hispanic students and non-Hispanic White students.

What contributes to Hispanic students taking fewer, and less rigorous, STEM courses in high school than non-Hispanic White students do? One possibility is that lower social or cultural capital available to Hispanic high school students restrains the formation of STEM identity, the ability to identify with STEM professions (DeWitt, Archer, Osborne, Dillon, Willis, & Wong, 2011; see also Aschbacher, Li, & Roth [2010] for additional discussion of cultural influences). Future studies could consider these and other possible factors influencing the academic experiences of Hispanic students in math and science in high school.

At the same time, high school counselors and administrators have an important role in recruiting Hispanic students into these courses and in counseling them on STEM careers. It is important to understand whether Hispanic students receive different guidance about taking high-level STEM courses and about career pathways than do other students, and whether changes in counseling can alleviate underrepresentation of Hispanic students in rigorous math and science courses. By the same token, further research is needed to understand the observed differences in STEM achievement by sex and to understand the mechanisms behind varying relationships between indicators and postsecondary STEM outcomes for female and male students, respectively. Understanding how these relationships differ for male and female students can help shed light on policy and practices that could help equalize STEM success for all students.

In light of these findings, more urgent implementation of policies and practices that promote rigor of courses offered as well as access to those courses could be considered. Increased participation in rigorous math and science courses in high school could reduce disparities in postsecondary STEM success between Hispanic students and non-Hispanic White students. Research might also consider examining practices to promote student interest or engagement in STEM activities (e.g., afterschool programs) in younger grade levels to encourage advanced course taking in high school. Other differences unrelated to high school coursework and achievement—such as a student's ties to the community and family, status as a first-generation graduate, and perception of the value of postsecondary STEM education—may influence student interest in STEM, student participation in advanced courses that pave the way for STEM pursuits, and ultimately postsecondary STEM outcomes. Because the indicators identified in this study as predicting STEM outcomes did *not* differ for Hispanic students, further investigation into why Hispanic students demonstrate lower levels of the indicators or the outcomes (enrolling in, persisting in, and completing a postsecondary STEM degree) could examine such individual factors.

We hope these results and the methodology inform future research, in Texas and elsewhere. Because the study used data that many states routinely collect or that are publicly available, other states might begin to explore their own datasets to identify similar relationships among indicators of STEM success.

To access the full public report, see: https://ies.ed.gov/ncee/edlabs/projects/project.asp?projectID=4485

References

Aschbacher, P. R., Li, E., & Roth, E. J. (2010). Is science me? High school students' identities, participation and aspirations in science, engineering, and medicine. *Journal of Research in Science Teaching, 47*(5), 564–582.

Beede, D., Julian, T., Khan, B., Lehrman, R., McKittrick, G., Langdon, D., & Doms, M. (2011). *Education supports racial and ethnic equality in STEM* (ESA Issue Brief 05–11). Washington, DC: U.S. Department of Commerce. Retrieved August 8, 2017, from http://files.eric.ed.gov/fulltext/ED523768.pdf

DeWitt, J., Archer, L., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2011). High aspirations but low progression: The science aspirations—careers paradox amongst minority ethnic students. *International Journal of Science and Mathematics Education, 9*(2), 243–271.

Ginder, S. A., Kelly-Reid, J. E., & Mann, F. B. (2016). *Postsecondary institutions and cost of attendance in 2015–16; degrees and other awards conferred, 2014–15; and 12-month enrollment, 2014–15. First look* (Preliminary Data). NCES 2016-112. Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Higher Education Research Institute. (2010, January). *Degrees of success: Bachelor's degree completion rates among initial STEM majors* (Higher Education Research Institute Research Brief). Los Angeles, CA: Author. Retrieved August 8, 2017, from http://www.heri.ucla.edu/nih/downloads/2010%20-%20Hurtado,%20Eagan,%20Chang%20-%20Degrees%20of%20Success.pdf

Langdon, D., McKittrick, G., Beede, D., Khan, B., & Doms, M. (2011). *STEM: Good jobs now and for the future* (ESA Issue Brief 03–11). Washington, DC: U.S. Department of Commerce.

National Center for Education Statistics. (2016). *Digest of education statistics, 2014* (NCES 2016–006). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics.

Vilorio, D. (2014, March). STEM 101: Intro to tomorrow's jobs. *Occupational Outlook Quarterly, 58*(1), 3–12.