POLICY BRIEF:

The Impact of Inclusive STEM High Schools on Student Outcomes: Evidence from Texas STEM Academies

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SUMMARY

Descriptive statistics results show that T-STEM academies enroll more STEM-underrepresented students who are African Americans or Hispanics, from low-income families, limited English program participants, lower achievers, and not enrolling in a gifted education program.

Pooled regression results indicate that there are generally no differences between T-STEM academies and traditional public high schools in student test scores across all academic subjects, including math, reading, science, and social studies, in 9th, 10th, and 11th grades, with the exception of math achievement in 11th grade.

Students attending T-STEM academies outscored their traditional public high school peers about 0.19 standard deviations in 11th grade math assessment tests. There are no significant differences in high school graduation and college attendance between T-STEM academy and traditional public high school students.

Background

Enhancing science, technology, engineering, and mathematics (STEM) education has been a national priority for maintaining a competitive edge in global economy (National Academy of Sciences, 2007; White House, 2011). At the K-12 level, STEM-focused schools are often viewed as the best approach to improve STEM education (National Research Council, 2011). In 2010, a report by the President's Council of Advisors in Science and Technology called for the establishment of 1,000 more STEM-focused schools within the next decade. Inclusive STEM high schools (ISHSs), which combine nonselective admission policies with a STEM-emphasized curriculum and college-going culture, represent an emerging STEM-focused school model that has been rapidly expanding across the country. In 2006, Texas launched the Texas STEM (T-STEM) initiative, the largest investment in ISHSs in the nation, and opened the first seven T-STEM Academies. The number of T-STEM Academies has increased exponentially, reaching 55 in 2011 and 121 in 2016.

Because of its recent emergence, rigorous evidence of the effectiveness of ISHSs is limited and the existing findings are mixed. Analyzing data from North Carolina, Means, Wang, Young, Peters, and Lynch (2016) found that ISHS attendance has a positive impact on STEM-related coursetaking and grade point average (GPA), but not on ACT scores, whereas Gnagery and Lavertu (2016) documented that a null or negative effect of enrolling in an ISHS on student test scores in both STEM and non-STEM subjects in Ohio. Several studies using data from Texas also found mixed effects of ISHSs on student achievement (e.g., Almus, Sahin, & Almus, 2016; Bicer, Navruz, Capraro, Capraro, Oner, & Boedeker, 2015; Young, House, Wang, Singleton, & Klopfenstein, 2011). This study adds to this growing literature on ISHSs by analyzing a decade-long data from Texas statewide longitudinal data system to assess the impact of T-STEM Academies on student achievement and educational attainment.

Key findings

The school sample of this study consists of 467 school-by-year observations of T-STEM Academies and 14,292 school-by-year observations of traditional public high schools from year 2006 to 2015. Table 1 reports background characteristics of T-STEM Academies and traditional public high school first-time 9th graders, who are the analytic samples in this study. Descriptive statistics show that first-time 9th graders in T-STEM Academies tend to be Hispanics or African Americans (non-white or non-Asian), low-income, limited English program participants, and not enrolling in a gifted education program. Notably, T-STEM Academies appear to enroll students with lower levels of prior achievement as measured by 8th grade TAKS test scores in math, reading, science, and social studies (about 0.07-0.08 standard deviations lower). This implies that there may be a negative selection bias of student population, which will need to be addressed when estimating the impact of T-STEM Academies on student outcomes.

Table 1. Background Characteristics of ISHS and Non-ISHS First-Time 9th Graders

	T-STEM		Traditional HS		Group Differences
	Mean	S.D.	Mean	S.D.	
Number of observations (2006-2015)	81,564		3,138,250		
Female	.500	.500	.504	.500	-.004
White	.155	.362	.354	.478	-.199***
Hispanic	.672	.470	.475	.499	.196***
Black	.133	.340	.126	.332	.007***
Asian	.036	.186	.040	.196	-.004***
Other race	.004	.062	.004	.065	.000
Immigrant	.023	.149	.022	.147	.001
Age	14.187	.507	14.201	.521	-.014***
Low-income	.697	.460	.511	.500	.186***
Limited English program	.102	.302	.074	.262	.027***
Gifted	.088	.283	.108	.311	-.020***
Charter	.208	.406	.017	.130	.191***
Number of observations (2006-2010)	17,608		1,378,380		
Prior achievement in 8th grade					
Math	.063	.886	.139	.877	-.076***
Reading	.052	.914	.136	.867	-.073***
Science	.074	.888	.155	.872	-.081***
Social studies	.083	.925	.150	.886	-.068***

Note. Excluding special education students, restricted to students aged 13-21.
* p<0.05, ** p<0.01, *** p<0.001

Table 2 presents the impact estimates of T-STEM Academies on student educational achievement and attainment from pooled regression analyses using all first-time 9th graders from earlier T-STEM Academies and traditional high schools that have Texas Assessment of Knowledge and Skills scores (TAKS; tested in springs 2007-2011 for 9th grade, springs 2008-2012 for 10th grade, and springs 2009-2013 for 11th grade). All models control for (a) student backgrounds, including gender, race/ethnicity, immigration status, age, economic disadvantage status, limited English program, gifted education; (b) school characteristics, including charter, high school enrollment, years since becoming ISHS; and (c) specific grade level (9th, 10th, or 11th grade) covariates, including total enrollment, percent of non-white/non-Asian students, percent of low-income students, percent of limited English program students, and percent of gifted education students (year and district fixed effects; robust standard errors clustered by schools). The pooled regression analysis results show that there are generally no differences in student test scores across all academic subjects, including math, reading, science, and social studies, in 9th, 10th, and 11th grades, with the exception of math achievement in 11th grade. Students attending ISHSs outscored their non-ISHS peers about 0.19 standard deviations in 11th grade math assessment tests. When examining high school graduation and college attendance statuses, it appears that there are no significant differences between ISHS and non-ISHS students.

Table 2. Estimated Impact of ISHS on Student Outcomes

	9th grade		10th grade		11th grade	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
TAKS Test Scores						
Math	.007	.019	.052	.069	.189*	.089
# of observations	1,384,023		1,206,569		1,123,836	
Reading	.006	.020	-.013	.047	.044	.073
# of observations	1,392,038		1,211,539		1,129,847	
Science			.018	.078	.041	.037
# of observations			951,261		886,311	
Social studies			.127	.084	.020	.085
# of observations			951,187		886,116	
	On-time		One year later			
Educational Attainment	S.E.	Coef.	S.E.	Coef.		
High School Graduation	.008	-.002	.008	-.002		
# of observations	1,395,356		1,395,356			
College Attendance	.011	.002	.011	.002		
# of observations	1,395,356		1,395,356			

Note. Excluding special education students, restricted to students aged 13-21. All models control for (a) student backgrounds, including gender, race/ethnicity, immigration status, age, economic disadvantage status, limited English program, gifted education; (b) school characteristics, including charter, high school enrollment, years since becoming ISHS; and (c) specific grade level (9th, 10th, or 11th grade) covariates, including total enrollment, percent of non-white/non-Asian students, percent of low-income students, percent of limited English program students, and percent of gifted education students. Year and district fixed effects. Robust standard errors clustered by schools.
* p<0.05, ** p<0.01, *** p<0.001

Conclusions

Developing, supporting, and studying best practices in STEM education for K-12 schools are some of the major efforts that policymakers, educators, and researchers can do to address the challenges of tomorrow's technology-driven economy in the state of Texas. The findings of this study suggest that T-STEM Academies, an emerging model of STEM-focused school model that has been rapidly expanding across Texas, have a modest positive impact on student achievement in math, which has been consistently shown in the literature that to be one of the strongest predictor of entering STEM professions.[1] This study is the first to analyze the Texas statewide longitudinal data with a large sample size of T-STEM Academies (467 school-by-year observations) and with an extensive set of control variables at the student- and school-level. Thus, the empirical results have both high statistical power and strong internal and external validity. The finding of the positive effect of T-STEM Academies on student math achievement, documented in this study, has important policy implications for public and private institutions that are interested in investing and expanding inclusive STEM high schools.

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[1] Future research will examine the impact of T-STEM Academies on student college major choice in STEM.