Inclusive STEM Schools:
Early Promise in Texas and Unanswered Questions

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Introduction

Mathematics and science—long the acknowledged domain of the academically gifted—lies at the crux of the knowledge economy, now and for the foreseeable future. For policymakers and reformers, however, endorsing a small, educated elite with strong academic training in STEM while a large proportion of the population remains ill-fitted to the new economy is untenable (National Research Council, 2005; PCAST, 2010). Inclusive STEM schools are predicated on the dual premises that math and science competencies can be developed; and that students from traditionally underrepresented subpopulations need access to opportunities to develop these competencies to become full participants in areas of economic growth and prosperity. Inclusive STEM schools do not screen prospective students on the basis of strong prior academic achievement. Rather, they build in supports to engage students in STEM and provide them with opportunities to master STEM content and related skills. Although inclusive STEM programs can exist in a wide variety of school contexts, this paper focuses specifically on standalone, whole STEM schools or schools-within-schools that operate as autonomous units. Other papers on this panel discuss findings on STEM learning opportunities within selective STEM schools, traditional schools, and CTE programs.

This paper presents early results on the effects of a large-scale inclusive STEM school initiative—T-STEM in Texas—and highlights factors that facilitate and constrain the ability of T-STEM academies to realize their goals. This paper also identifies key research needs to better understand the effects of inclusive STEM schools going forward. Data come from the 4-year longitudinal evaluation of the Texas High School Project (THSP). That evaluation studies the implementation and impact of T-STEM and the other THSP reforms using a mixed-methods design, including qualitative case studies; principal, teacher, and student surveys; and a quasi-experimental approach to examining the effects of the programs on student achievement and achievement-related behaviors.[1]

[1] See Appendix A for methods details.

The T-STEM Initiative

With an investment of approximately $120 million in 51 academies and 7 T-STEM technical assistance centers (as of 2009-10), the T-STEM initiative in Texas is the largest investment in inclusive STEM high schools in the U.S. The first T-STEM schools opened in 2006-07.[2] In addition to funding individual T-STEM schools, the THSP alliance built a statewide technical assistance infrastructure through seven regional T-STEM centers. They are intended to support T-STEM academy start-ups specifically and to improve math and science education statewide.

A relatively detailed T-STEM "blueprint"[3] guides school leaders' planning and implementation of T-STEM academies. It articulates central tenets for T-STEM academies, including providing a rigorous academic curriculum, instruction relevant to real-world problems and careers, accelerated access to STEM coursework, and personalized learning supports for students. By design, T-STEM academies are also small schools, serving approximately 100 students per grade. They may be run by a district or a charter management organization (CMO). The blueprint stipulates that T-STEMs academies must be nonselective. They cannot select students based on prior performance and must have a student population that is more than 50% economically disadvantaged or more than 50% from ethnic/racial minority groups. The T-STEM academies are typically located in high-need areas, mainly the inner cities of the major metropolises and rural Rio Grande Valley and East Texas. Exhibit 1 illustrates the characteristics of students served by the T-STEM academies and other THSP schools that were in operation at 2008-09 compared with non-THSP schools. In keeping with the blueprint, a larger proportion of students in T-STEM schools was economically disadvantaged and drawn from racial/ethnic minorities than in non-THSP high schools.

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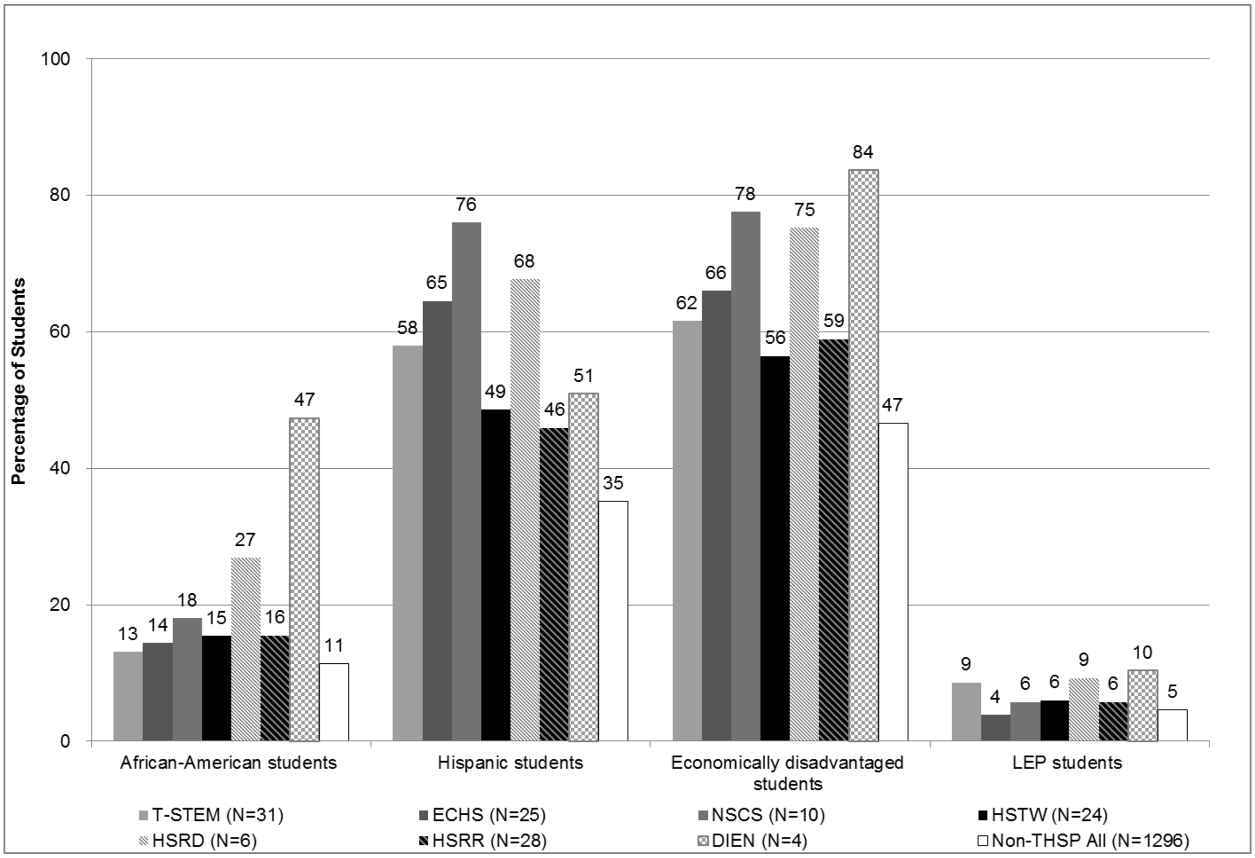
[2] T-STEM is one of multiple high school reform initiatives under the Texas High School Project, formed by an alliance of state public agencies and private foundations The alliance includes the Texas Education Agency (TEA), Office of the Governor, Texas Legislature, Texas Higher Education Coordinating Board (THECB), Bill & Melinda Gates Foundation (BMGF), Michael & Susan Dell Foundation, Communities Foundation of Texas (CFT), National Instruments, Wallace Foundation, Greater Texas Foundation, and Meadows Foundation. THSP includes multiple initiatives including T-STEM, Early College High School, New School/Charter Schools, and various comprehensive high school reform programs: High Schools That Work, High School Redesign and Restructuring, and High School Redesign, and District Engagement.

[3] T-STEM Blueprint, 2010 revision available at http://nt-stem.tamu.edu/Academies/blueprint.pdf

Exhibit 1
Selected Student Characteristics of T-STEM, Other THSP, and non-THSP Schools, 2008-09



Notes: The number of schools is shown in parentheses after each school category. Non-THSP schools refer to all non-THSP schools in the state serving grades 9, 10, 11, or 12.

T-STEM, Early College High School (ECHS), and New Schools/Charter Schools (NSCS) fund new start-ups; High Schools That Work (HSTW), High School Redesign (HSRD), High School Redesign and Restructuring (HSRR), and District Engagement (DIEN) fund reforms at existing comprehensive high schools.

Source: Academic Excellence Indicator System (AEIS) 2008–09 academic year. Excerpt from Young, et al., 2010, Exhibit 2-3, p. 14.

With these student characteristics as context, the next section presents findings on T-STEM effects to date, followed by a discussion of factors that affect T-STEM implementation.

Outcomes Required and Outcomes Desired

Achievement Results for T-STEM and Comparison Schools

Not surprisingly, the achievement outcomes that T-STEM academies commonly pursue are determined largely by the broader state accountability context. Although T-STEM academies have attained acceptable, recognized, or exemplary ratings in the Texas accountability system—thus escaping the turnaround pressures at underperforming schools—they nonetheless monitor student performance closely throughout the year to ensure that students meet or exceed the annual Texas Assessment of Knowledge and Skills (TAKS) proficiency standards. These outcomes constitute the most emphasized measurable outcomes in the state. Success on TAKS is essential to the prospects of any given T-STEM academy, not only because of its importance for students, but also in terms of building a reputation for academic excellence that will attract future students.

The THSP evaluation design called for longitudinally tracking students beginning in the 9th grade. The latest available analyses show TAKS achievement results and other measures of progression for 9th-, 10th-, and 11th-graders served by T-STEM academies in 2008-09.[4] These results combine the effects for T-STEM academies that began operations in 2006-07, 2007-08, or 2008-09.[5] To estimate the effect of T-STEM and the other THSP programs, we matched comparison schools to each THSP school (including T-STEM academies) using a combined exact matching and propensity score matching method.[6] Our approach took into account a wide range of observable school-level characteristics including student demographics, prior achievement, accountability rating, teacher experience, and teacher demographics. The effects for each of the THSP programs, including T-STEM, were estimated together in the same hierarchical models to maximize statistical power, controlling for student-level demographics and prior achievement and school-level characteristics. (Appendix A provides detailed methods.)

In 2008-09, T-STEM academy students scored slightly higher than matched comparison school

[4] The third annual report for the evaluation of the Texas High School Project is scheduled for release in summer 2011 and will include the effects of T-STEM on student outcomes in 2009-10, including graduation and drop out for the 9th-grade class of 2006-07.

[5] T-STEM academies funded to beginning as middle schools were not included in the THSP evaluation until they year they began serving ninth-graders.

[6] THSP schools were matched within specified ranges on key school-level characteristics affecting student achievement, including grad span, campus accountability rating, TAKS math and TAKS reading passing rates for the prior year, urbanicity, enrollment, Title I status, and percentage of African-American and Hispanic students. Where more than six comparison schools met these criteria, the six schools closest in propensity score to the THSP school were retained as the comparison schools. Appendix A provides further details.

peers on 9th-grade TAKS math and on 10th-grade TAKS math and TAKS science.[7] The effect sizes are relatively small, ranging from 0.12 to 0.17 standard deviations, but are positive and in the STEM areas. In addition, 9th-graders in T-STEM schools had a higher likelihood (1.8 times) of passing both TAKS reading and TAKS math (the two subjects tested at that grade), and 10th-graders had a marginally significant ($p < 0.10$) higher likelihood (1.5 times) of passing TAKS in all of the four core subjects. Ninth-grade students in T-STEM academies also had a lower likelihood (0.8 times) of being absent from school than did students in the matched comparison schools. The T-STEM advantage appears to be subject-specific rather than an overall enhancement of academic performance. T-STEM academy students performed similarly to those in the matched comparison schools on 9th-grade TAKS reading, and 10th-grade TAKS English and TAKS social studies.

No significant differences were found for T-STEM 11th-graders, but this result likely reflects the very small school sample as only two T-STEM academies served 11th-graders in 2008-09. Exhibit 2 tabulates the results for all of the outcomes analyzed through the THSP evaluation and Exhibits 3 through 6 graphically display the differences between T-STEM and comparison schools.

[7] All results statistically significant at $p < 0.05$ unless otherwise specified.

Exhibit 2
T-STEM Effect on Ninth-, Tenth- and Eleventh-Grade Outcomes in 2008–09

Student Outcome	Ninth Grade	Tenth Grade	Eleventh Grade
TAKS Math			
Coefficient	27.16 *	20.97 *	-33.71
SE	8.51	9.34	32.48
Effect size	0.12	0.12	-0.18
TAKS Reading			
Coefficient	-10.35	6.18	-14.44
SE	6.83	7.12	24.37
Effect size	-0.06	0.05	-0.10
TAKS Science			
Coefficient		28.98 *	-4.49
SE		8.53	24.95
Effect size		0.17	-0.03
TAKS Social Studies			
Coefficient		7.65	29.16
SE		9.20	30.26
Effect size		0.04	0.18
Passing all core TAKS			
Coefficient	0.57 *	0.40 ◊	-0.28
SE	0.17	0.21	0.98
Effect size	0.34	0.24	-0.17

Note. Passing all core TAKS is logits and coefficients need to be interpreted as odds ratio.
*p < 0.05. ◊p <.10.

Exhibit 2 (continued)
T-STEM Effect on Ninth-, Tenth- and Eleventh-Grade Outcomes in 2008–09

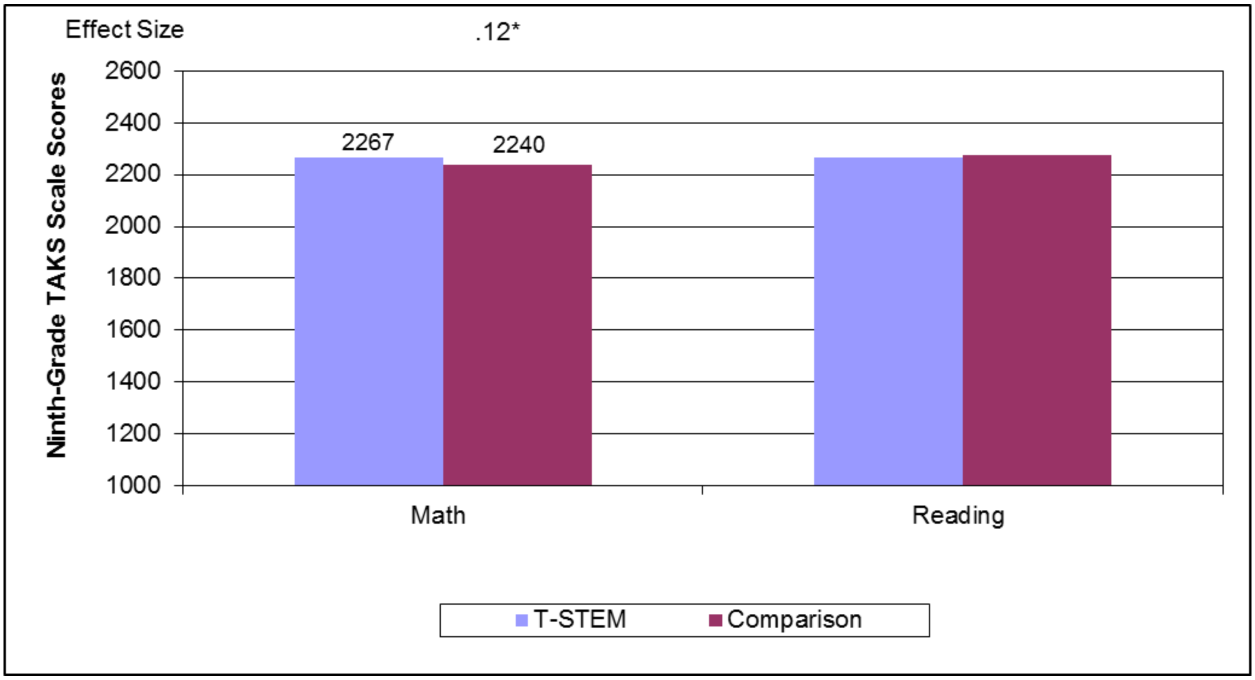
Student Outcome	Ninth Grade	Tenth Grade	Eleventh Grade
Passing Algebra I			
Coefficient	-0.12		
SE	0.20		
Effect size	-0.07		
Odds ratio	0.89		
Accelerated learning			
Coefficient			-1.24
SE			1.11
Effect size			-0.75
Odds ratio			0.29
Absence rate			
Coefficient	-0.23 *	-0.08	0.12
SE	0.08	0.06	0.15
Effect size	-0.14	-0.05	0.07
Odds ratio	0.80	0.93	1.13
Promoted to tenth/eleventh grade			
Coefficient		0.31	1.39
SE		0.49	1.24
Effect size		0.19	0.84
Odds ratio		1.36	4.01
Number of students in the analysis[a]			
T-STEM program	1,406	696	86
Comparison	151,576	12,053	804
Total	152,982	12,749	890
Number of schools in the analysis[a]			
T-STEM program	30	14	2
Comparison	132	81	12
Total	162	95	14

[a]The Ns are the number of students and schools used in the absence rate analysis.

Notes: Passing Algebra I, accelerated learning, absence rate, and promoted to 10th or 11th grade are logits and coefficients need to be interpreted as odds ratio.

$^{*}p < 0.05$. ◊$p < .10$.

Exhibit 3
T-STEM Effect on Ninth-Grade TAKS Scores in 2008–09



Notes: Average of model-implied estimates for total THSP and comparison school students based on total THSP and comparison school sample.

Values are shown and effect sizes are labeled on top of the bars for significant TAKS score differences.

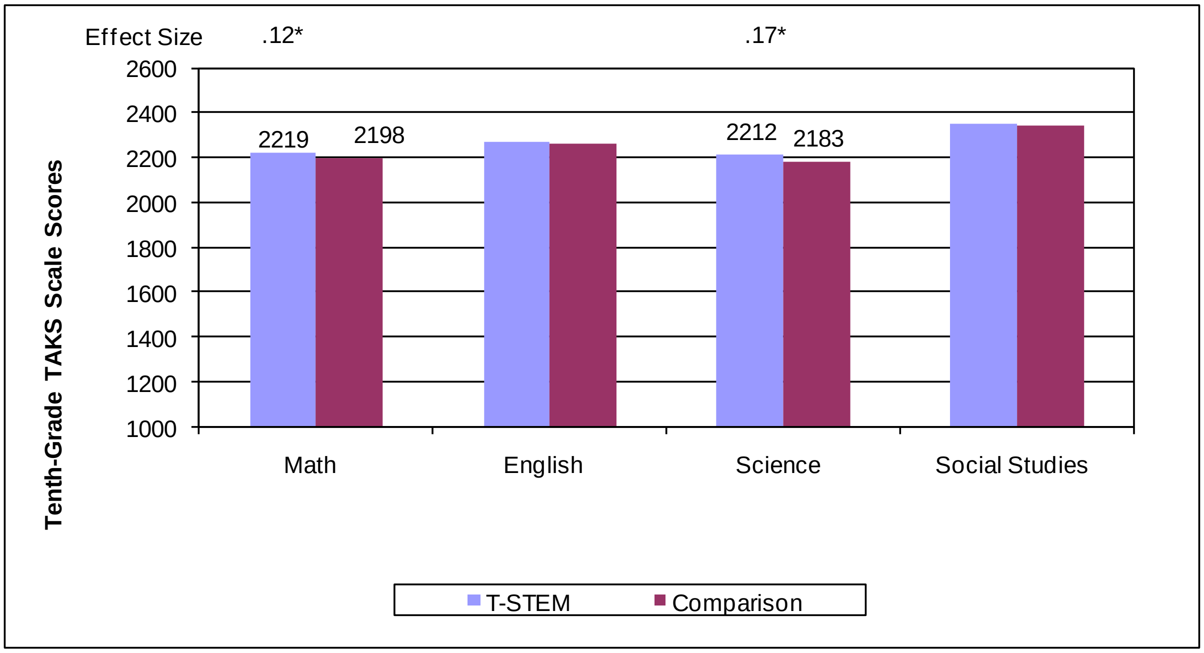
*p < .05, ◊p < .10.

TAKS passing rates are set at a scale score of 2100 and TAKS commended status is set at a scale score of 2400 every year for each TAKS subject in each grade.

1,406 students from 30 T-STEM schools and 151,576 students from 132 comparison schools are included in the analyses.

Excerpt from Young, et al. (2010), Exhibit 3-4, p. 43.

Exhibit 4
T-STEM Effect on Tenth-Grade TAKS Scores in 2008–09



Notes: Average of model-implied estimates for total THSP and comparison school students based on total THSP and comparison school sample.

Values are shown and effect sizes are labeled on top of the bars for significant TAKS score differences.

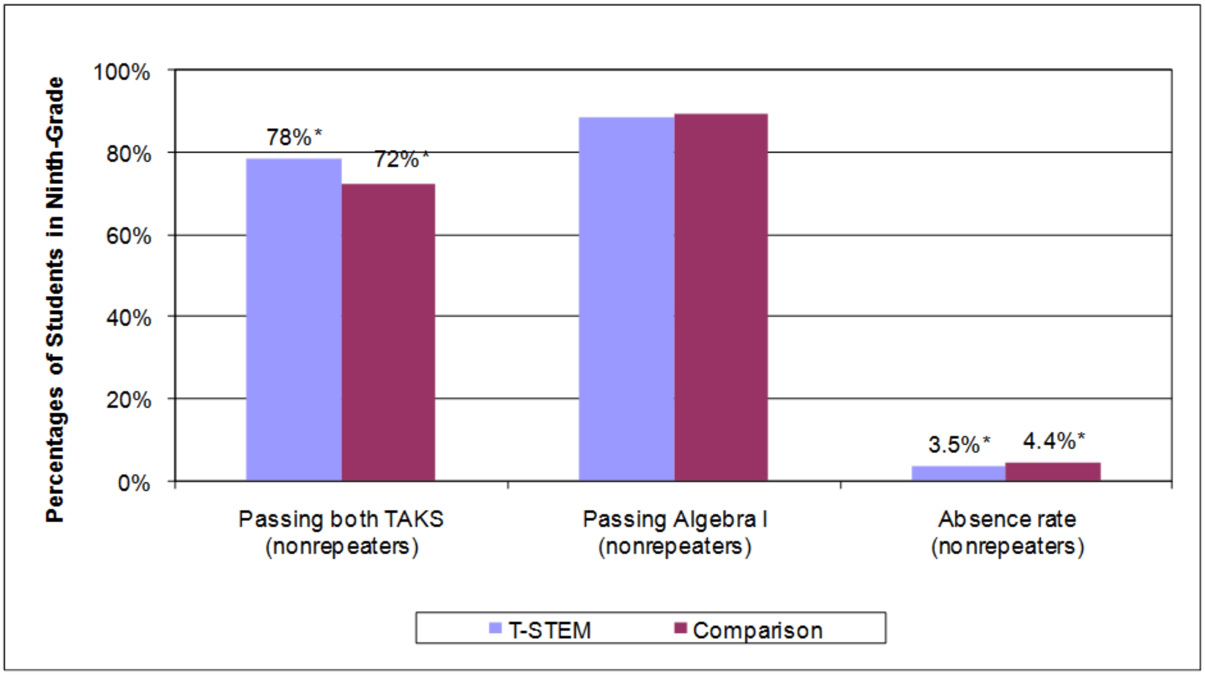
*p < .05, ◊p < .10.

TAKS passing rates are set at a scale score of 2100 and TAKS commended status is set at a scale score of 2400 every year for each TAKS subject in each grade.

696 students from 14 T-STEM schools and 12,053 students from 81 comparison schools are included in the analyses.

Excerpt from Young, et al. (2010), Exhibit 3-5, p. 44.

Exhibit 5
T-STEM Effect on Ninth-Grade Outcomes Other than TAKS Scores in 2008–09



Notes: Average of model-implied estimates for total THSP and comparison school students based on total THSP and comparison school sample.

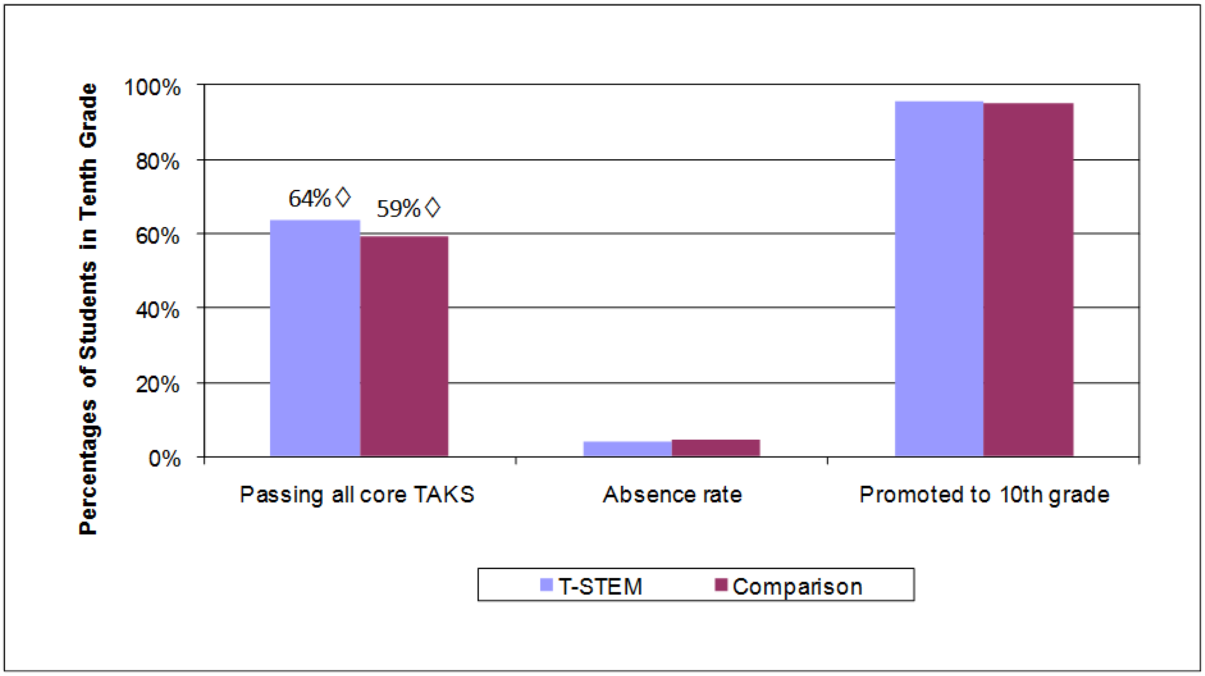
Values are shown for significant differences in outcomes.

*p < .05, ◊p < .10.

1,406 students from 30 T-STEM schools and 151,576 students from 132 comparison schools are included in the analyses.

Excerpt from Young, et al. (2010), Exhibit 3-7, p. 46.

Exhibit 6
T-STEM Effect on Tenth-Grade Outcomes Other than TAKS Scores in 2008–09



Notes: Average of model-implied estimates for total THSP and comparison school students based on total THSP and comparison school sample.

Values are shown for significant differences in outcomes.

*p < .05, ◊p < .10.

696 students from 14 T-STEM schools and 12,053 students from 81 comparison schools are included in the analyses.

Excerpt from Young, et al. (2010), Exhibit 3-8, p. 47.

These achievement results are promising, coming relatively quickly after the T-STEM academies' founding; in 2008-09, the T-STEM academies included in these analyses were in their first through third year of operations. The results for 2009-10 will provide 12th-grade outcomes for the first cohort of 9th-graders served under the T-STEM initiative. Unfortunately, the small number of schools that will have actually graduated a class of seniors prior to the end of the THSP evaluation means that the evaluation will conclude before capturing any longer-term effects on students and before the T-STEM schools have matured beyond their start-up phase.

Faculty and Family Choice

All of the T-STEM academies are schools of choice. Families clearly choose to send their children to T-STEMs, and they do so for a wide variety of different reasons. Some students report that they or their parents were attracted to the college prep program in general; some want a safe and orderly environment; some want to escape a neighborhood school with a bad reputation; some are enticed by access to new technology. Relatively few know they want a career in a STEM field and see the T-STEM academy as the stepping stone. Thus, not all T-STEM students are inherently more interested in STEM or academics than students at other schools, but they did choose to attend the T-STEM academy which indicates a level of concern about the nature of their education. While the T-STEM academies are matched carefully on a broad range of school-level student and teacher characteristics and the analyses control for student characteristics in multilevel models, the unobserved differences in family motivation and academic orientation confounds the T-STEM effects with selection effects. A study building on these findings should account for student self-selection.

T-STEM academies also report that some students leave because they do not fit into the school culture or do not want to make the extra effort that the more rigorous curriculum—at least compared to their former school—requires. For the analysis presented above, only those students who remain at the same school and are promoted to the next grade are included in the analysis the subsequent year. The sample attrition—which includes both those who leave the school and those who are not promoted to the next grade—from the 9th-grade in 2007-08 to the 10th-grade in 2008-09 is 22%, and from 10th-grade in 2007-08 to 11th grade in 2009-10 is 35%. Again, it is important to note that the 11th-grade cohort in 2009-10 come from only two schools. These attrition rates are comparable to those at the other small schools of choice funded under THSP. Importantly, the T-STEM attrition from 9th to 10th grade is similar to the percentages at the THSP comprehensive high schools and the attrition from 10th to 11th grade is in the middle of the range experienced among the comprehensive high school reform programs under THSP. Although these analyses include only two cohorts of students, these findings on sample attrition suggest that students may not be leaving T-STEMs at higher rates than those at comprehensive high schools. Nonetheless, these attrition rates are a significant proportion of the initial 9th-grade cohort and merit attention.

Self-selection operates at the teacher level as well. For the standalone T-STEMs that are opened by CMOs, teachers are attracted to the start-ups in much the same way as teachers are generally attracted to new charter schools—they typically express strong buy-in to the school mission. At non-charter T-STEMs or schools-within-schools, local district teachers have the option of teaching at the T-STEM and usually had the first right of refusal. Some element of choice exists for teachers at these T-STEMs, although it is less pronounced than at the charter schools.

Other Outcomes

Notwithstanding state accountability pressures, T-STEM academies strive to achieve a broad range of outcomes including college readiness, 21st-century skills, and STEM career-related experiences. The T-STEM Blueprint specifically articulates outcomes of preparing students for "postsecondary coursework and careers in science, technology, engineering, and mathematics through the integration of the Governor's economic workforce clusters and Achieve Texas STEM cluster"[8] (THSP, 2010, p. 5).

Staff at the T-STEM academies themselves express their primary goal and desired outcome as college preparation and enrollment, given their mission to serve underrepresented students, many of whom would be first-generation college students. Enroute, the schools emphasize related student attitudes, habits, and aspirations. For example, the schools explicitly aim to develop students' sense of identity as future college-goers and to instill disciplined work habits and responsibility for their own learning, positive attitudes towards academics, and effort-based approaches to learning (Dweck & Molden, 2005). However, these outcomes are not systematically tracked at the school level. Rather, the T-STEM academies see these attitudes and behaviors as the product of a school culture featuring consistently high expectations focused on college-going, respect among teachers and students, and strong connections between each student and his or her teachers. Not unlike other leaders at new small schools

[8] Clusters include: "semiconductor industry, information and computer technology, micro-electromechanical systems, manufactured energy systems, nanotechnology, biotechnology, chemist, and engineering: aerospace, electronic, mechanical, environmental, and biomedical" (THSP, 2010, p. 5).

(particularly at charters), T-STEM principals report that "getting the culture right" is the most important task of a school's first years. Indeed, external T-STEM coaches tasked with supporting academy principals in planning and early implementation train their eye on school culture, and the T-STEM Blueprint (2010) identifies "mission-driven leadership," "personalization," and "culture" as central implementation foci in the first year.

More tangibly, many of the T-STEM academies also strive to develop students' "21st-century skills," such as working productively on teams, using interdisciplinary approaches to problem-solving, applying technology, and communicating through multiple channels. The degree to which the T-STEM academies try to measure these skills depends on the extent to which developing these skills are integral to the school's instructional model. For example, some T-STEMs participate in The New Tech Network, which specifically structures the curriculum around multidisciplinary projects for each unit, with students working in teams for almost every project, and with every project culminating in a product that is presented to the class and occasionally to outside community members. Teachers build project-specific rubrics that incorporate collaboration and presentation, and assess students individually on content that spans the (typically) two subject areas integrated into the project. At other T-STEM academies, the "soft" skills are not explicitly assessed; rather, the schools encourage experiences through which students are presumed to have opportunities to develop such skills, for example by working on a FIRST Robotics competition team after school.

The academies also aim to give students work-based internships as learning experiences to broaden their interests and understanding of career options. In general, the T-STEM academies are still defining the types of internships they would like to provide their students and trying to generate viable partnerships. While they track the number of students who have internship placements, the schools have not developed the capacity to systematically measure the quality of those internships or what students gain from them.

The T-STEM academies' primary goal, college readiness, can be examined using several indicators available in the state data. A state college readiness indicator is set as a scaled score of 2200 on TAKS, compared to 2100 as meeting TAKS standards and 2400 as commended. Estimates developed in the THSP evaluation suggest that 9th-graders[9] in T-STEM academies reach that college readiness benchmark on TAKS math, as they do in the comparison schools. Texas districts also are required to offer students the opportunity to earn 12 semester credit hours of college credit while in high school, a requirement that can be fulfilled by Advanced Placement (AP), International Baccalaureate (IB), or dual-credit courses that the district offers in partnership with a local college. The 11th-grade T-STEM students may have a higher likelihood of taking AP, IB, or dual credit courses than those in comparison schools. The probability of taking one of these courses for the average student is 61% at T-STEM academies compared with 39% at the matched comparison schools, although these results were not statistically significant (likely due to the small number of T-STEM schools serving 11th graders in 2008-09 noted previously).[10]

The ultimate outcomes of increased college enrollment, persistence, and graduation are not readily tracked by T-STEM academies, nor indeed by most high schools in Texas. Data from the Texas Higher Education Coordinating Board (THECB) data can be matched to those from TEA for students who remain in state for college, but the THSP evaluation will not continue long enough to follow T-STEM students beyond high school graduation.

For the T-STEM academies to assess their own progress in meeting goals of increased student college enrollment, persistence, and graduation, the schools will need consistent data annually, with specific guidance about how to define high school graduation (e.g., by cohort, within 4 years, include or exclude GED, etc.), college enrollment, persistence (e.g., how to count students who opt for a gap year or step out during college), and whether to include all forms of postsecondary institutions. In addition to integrating existing TEA and THECB data at the student level, some form of data collection or agreement with the National Student Clearinghouse would be necessary to track students who leave the state for

[9] Model estimates based on the average characteristics for students in the total THSP and comparison school sample.

[10] 86 students in 2 T-STEM schools compared to 804 students from 12 comparison schools.

college. In the absence of reliable and consistent longitudinal data, a few T-STEM academies seek out anecdotal reports from their alumni on how well and in what ways the school prepared them for college, and the ways in which the alumni believe the schools need to improve. While useful for the schools, such anecdotal data do not provide sufficient evidence to inform policymaking.

Although policymakers have the long view in sight, it is important to note that in these early years, the T-STEM academies are primarily focused on putting in place the components specified in the T-STEM Blueprint, instructional and otherwise. They must also attend to the typical start-up pressures—finding and retrofitting facilities, recruiting and training teachers, recruiting students, establishing procedures for an expanding school, and so on. The goals of producing more STEM college majors and professionals seem very distant when confronting the pressing needs of ninth-graders, who often enter these schools ill-prepared. The T-STEMs concentrate on bringing them up to grade level in one year and then sustaining their achievement to avoid falling under Texas's accountability sanctions. The T-STEM academies' aim to graduate their students from high school and get them accepted to college is best understood within this context.

Factors Influencing T-STEM Academies' Implementation and Outcomes

The expectations for T-STEM academies' development, as laid out in the T-STEM Blueprint, are multidimensional and ambitious. Evaluation findings during early implementation indicated that the T-STEM academies could not implement the many blueprint components all at once, and they deliberately staged their initiation of different activities, postponing those involving upper-year students for later implementation. Program officers revised the T-STEM Blueprint in 2010 to acknowledge such developmental phases and to provide guidance with respect to priorities during planning, the first year, and the second year of operation. Factors that the THSP evaluation case studies found influencing the schools' ability to implement and achieve the T-STEM design and goals include the school's primary affiliation with a district or CMO network, strategies to support the target student population, state policy, and as already discussed, the fact that the T-STEM academies were opened as schools of choice.

Primary Affiliation

Our understanding of the factors affecting T-STEM implementation and early results is limited by the confounding of these factors with the typical pangs associated with starting new schools or converting a large school to a set of smaller schools within a school. T-STEM academies experienced the predictable pains of conversion and start-up described in prior studies of small high schools (cf. AIR/SRI, 2005; Kahne, Sporte, & de la Torre, 2006; Young, et al., 2009).

The THSP evaluation shows that the primary affiliation of the T-STEM academy constitutes one of the largest influences on its instructional vision, approach and capacity. These affiliations define distinctive features of the school. For example, T-STEM academies belonging to the New Tech Network pursue project-based learning with team-teaching across subject areas, week in and week out. All students at Harmony schools, a CMO replicating campuses statewide under T-STEM, must participate in a science fair that consumes their extracurricular and sometimes class time for about four months of the school year. Other CMOs and districts allocate instructional coaches, have literacy initiatives, or promote family education strategies that their T-STEM academies layer on. The T-STEM Blueprint components plus these local efforts become the instantiation of T-STEM at that locale or for that district or CMO.

District and CMO affiliations provide important capacity-building, not just in terms of personnel and identifying the expertise they expect to matter (e.g., literacy across the curriculum), they also provide knowledge resources. For example, the New Tech Network offers institutes that train teachers in a systematic approach to scaffolding project-based learning and student collaboration. In cases where CMOs with solid replication strategies and experience are opening T-STEMs, they have centralized how they provide some or many of the start-up supports to new campuses and the often transfer teacher leaders from schools already up and running to launch their new campuses. Such influences are not unique to T-STEM, but they have been integral to the initiative’s enactment.

Supporting Student Success

An essential characteristic of the T-STEM academies is their climate of high academic expectations and the rigorous curriculum they expect all students to complete. They expect students to take more advanced math and science courses in preparation to succeed in higher education. For students transitioning to these academies, typically coming from lower-performing schools, the challenge of meeting these expectations can be quite difficult.

The T-STEM academies offer student services much like those in other Texas high schools. In response to the high-stakes testing in the state, teachers across all types of THSP schools, including the T-STEM academies, provide tutoring to students—before school, after school, at lunch, and on weekends. One T-STEM academy goes further, using a trimester calendar to provide credit recovery opportunities during the school year to keep students on track to graduate with their respective cohorts.

The T-STEM Blueprint also requires academies to establish advisories,[11] which provide teachers with dedicated time to support students in small class settings but outside of regular courses. The advisories as implemented in T-STEM academies differ in purpose and frequency. For example, one school focused advisory on fostering relationships between teachers and students, building character through readings and discussions, and supporting academic success through regular check-ins about courses, homework, grades, and attendance. The other school focused advisory on preparatory skills, such as practicing for the SAT and preparing college materials like resumes, personal statements, and financial aid. At schools that use advisories less, staff rely on the small school structure to ensure that each student feels connected to the school community.

Across the majority of T-STEMs, teachers and students reported that the small size of their schools facilitated strong relationships. Indeed, T-STEM staff articulate the criticality of every student having teachers who know them as learners and as individuals, in whom the student can confide about the

[11] The T-STEM Academy Blueprint defines advisories as a time "that is regularly scheduled,… and focuses on personalizing the student experience, (builds relationships with students and parents, develops character, and fosters global literacy)" (THSP, 2010, p. 5).

personal concerns they bring to school that affect their concentration and engagement. Some CMOs and districts with T-STEM academies have begun to use data systems that allow teachers to carefully and frequently track student work and performance for individual students, further guarding against students falling through the cracks.

To improve students' preparation for a demanding STEM high school curriculum, CMOs and districts, to a lesser extent, have turned their attention to middle schools. Many of the charter schools funded under T-STEM begin at the middle school level and strive for vertical alignment, particularly in math and science, in order to help middle school teachers increase the rigor of their courses. In another instance, a district has promulgated project-based instructional strategies and provided corresponding training to teachers in its middle and elementary schools to help students at those levels develop the skills needed to succeed at the T-STEM academy.

State Policy Context

While T-STEM academies may offer families a distinctive educational alternative, several key elements promulgated in the T-STEM Blueprint are reinforced by state policy and expected of all Texas high schools. As discussed previously, the state tracks college readiness indicators for every high school, requires every district to offer a minimum number of dual-credit opportunities, and mandates the "four by four" curriculum[12] for high school graduation. While these state policies are also encoded in the T-STEM Blueprint, several T-STEM academies expressed concern that by applying these mandates to all schools the state has eroded their niche as college preparation programs emphasizing math and science and targeting disadvantaged students.

While state accountability policies exert significant influence over many aspects of curriculum and instruction, T-STEM academies in our study ranged in the extent to which they perceived state assessments as directly aligned with their objectives and those who saw the assessment and accountability system as a necessary compliance activity but devoted their efforts to goals not measured or supported by

[12] Students are required to take four years of English, math, science, and social studies to graduate.

the state assessments. These differences generally revolved around T-STEMs featuring more traditional pedagogy with explicit TAKS preparation and those that used projects throughout the curriculum to challenge students at individually appropriate levels of rigor. On a day-to-day basis, teachers at these schools focus on projects aligned to specific learning outcomes and use assessments embedded in the projects to evaluate individual students' skills and knowledge. Overall, interviews with T-STEM teachers and school leaders revealed that such project-based learning, a key component specified in the T-STEM Blueprint, is not implemented consistently across T-STEM academies and that TAKS remains a critical indicator of success.

The current fiscal straits in Texas mean that for now, no new T-STEM academies will be funded. However, the confluence of publicity around the importance of STEM, the apparent success of the T-STEM academies, the possibility for attracting students, and low entry barriers has led a number of Texas schools to declare themselves as STEM schools. This grassroots interest is perhaps the best alternative for continuing to scale the initiative given the state's diminished resources. At the same time, some Texas policymakers express concern that school-initiated replications pose the risk of diluting the T-STEM brand, in terms of quality (true focus on STEM, college readiness, understanding of project-based learning) and mission (serving disadvantaged students). Following the example of the Early College High School designation process, which is also under the THSP umbrella, T-STEM program officers are planning to implement a T-STEM designation or accreditation process to assure that schools using the T-STEM moniker actually implement the components central to the blueprint.

Ultimately, the strategy of starting new schools has natural limits as a strategy for improving STEM education statewide. The vast majority of students attend traditional comprehensive high schools in their neighborhoods, and it is highly unlikely that the system capacity exists to provide enough slots to offer every family in the target population the choice to attend a specialized, inclusive STEM school. Thus, state policy may play an additional role in stimulating the spread of T-STEM academy practices to comprehensive high schools. The T-STEM Centers provide a statewide infrastructure that may be a useful conduit for not only T-STEM specific goals such as project-based learning, but also generalized lessons about helping underrepresented students achieve at high levels in math and science.

Conclusion, Implications, and Next Steps

Early Promise of One Inclusive STEM School Initiative

These early results suggest that the T-STEM academies opened in 2006-07, 2007-08, and 2008-09 have small but statistically significant, positive effects in standardized math scores for ninth-graders and in standardized math and science scores for 10th-graders compared to peers in matched schools. We have some understanding of how the schools support math and science achievement among students who are not necessarily well-prepared for a rigorous high school curriculum. Academic supports reflect strategies such as one-on-one tutoring, small-group pull-outs, and extensive credit recovery, which are employed statewide in many different types of schools. Of distinctive importance at T-STEM academies is the combination of a climate of high academic expectations; the small school structure, which teachers rely on to facilitate close relationships between adults and every student; and the provision of a college preparatory curriculum supported by teachers' use of data to monitor daily each student's attendance and progress. Consistent with policy implementation research (Cohen & Hill, 2000; McLaughlin, 1987; Spillane, 1998; Weatherley & Lipsky, 1977), the extent to which T-STEM academies implement this constellation of strategies varies according to local contexts that include the schools' respective district or CMO initiatives and external supports.

We also know that in the case of T-STEM, newly opened inclusive STEM schools enjoy the same benefits and suffer from the same challenges as other start-up schools. They grapple with supporting relatively high proportions of new teachers, integrating a growing staff and student body, establishing operational procedures, and developing curriculum and a common vision of instruction. On the positive side, they are able to hire teachers who express commitment to the school's mission, and families actively choose to attend the schools, albeit for a variety of reasons. They start the schools with a specific definition of, and strategies to foster, a college-oriented and caring culture.

Unanswered Questions to Guide Future Study

Despite these findings on inclusive STEM schools, our knowledge of their effects and dimensions that potentially lead to those effects remains limited. The available data measure only a subset of the outcomes that T-STEM academies strive to achieve. These schools believe in the importance of developing their students' 21st century skills. However, schools vary in the extent to which they incorporate the development of those skills into curriculum and they are inconsistent with respect to building in assessments to measure students' performance on those skills.

Our knowledge is limited also by the immaturity of the initiative. The field will have to wait to see sufficient numbers of students attending inclusive STEM schools reach the age of high school graduation and college entrance. The THSP evaluation will have longitudinal outcomes analyses for one small cohort of students from 9th- through 12th-grade. During the timeframe of the evaluation, we will not be able to determine whether attending STEM high schools has an effect on students' postsecondary outcomes, specifically college enrollment, persistence, or graduation.

We also do not know whether STEM high schools stimulate or deepen students' STEM interests and opportunities, leading to STEM majors, and STEM careers. Indeed, across T-STEM academies, college readiness and providing students with necessary supports and opportunities to be a competitive college applicant is the dominant priority. Producing STEM majors is seen as an important but secondary—and certainly distant—goal. Long-term outcomes should be investigated with a more inclusive definition of success. Raising students' general level of science and math literacy and providing them sufficient preparation to continue learning and to be trained in technical occupations are arguably as important as increasing the number of STEM majors.

Finally, even though Texas offers the largest scale STEM initiative to date and has relatively easy-to-use student-level data, these results are situated within its specific state policy context. A national study on the effects of inclusive STEM academies with careful attention to how the schools serve different underrrepresented student subpopulations would increase our understanding of the role of state policy, as well as the generalizability of these findings. Means et al. (2008) developed a framework to characterize inclusive STEM high schools based on a national sample of specialized STEM schools that delineates design dimensions, implementation practices, and student outcomes. Applying that framework and leveraging these early T-STEM findings point to a longitudinal study design that accounts for school choice to determine how state and local policy, students' STEM high school experiences, and STEM school characteristics lead to or mediate students' high school and postsecondary outcomes.

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