RESEARCH REPORT

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Economic Impact Assessment of SFA JacksTeach STEM PBIC Pathway

STEPHEN F. AUSTIN STATE UNIVERSITY
Center for Business and Economic Research

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Housed in the Department of Economics and Finance in SFA's Rusche College of Business, the nonprofit center offers data analysis, market research and economic impact analysis to the community while providing real-world training to SFA students for their future careers.

CBER also works to inform the public about the impact of national and state policies on the local economy, the effects of major events on the economy, and the role of new initiatives, such as the Interstate Highway 69 corridor, in local economic efforts.

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Introduction and Background

The CBER staff were engaged by the faculty in the College of Science and Mathematics to perform an economic impact analysis of a proposal that would result in increasing the number of highly-trained STEM teachers in East Texas. Specifically, SFA faculty in mathematics education are seeking to establish a post-baccalaureate alternative certification program (PBIC), which is based on the UTeach model of STEM teacher preparation. The goal of the program is to prepare and graduate teachers of science and mathematics who can serve areas of the state, particularly the East Texas region, where STEM education is known to be lacking at the public school level.

SFA services East Texas as a hub for STEM teacher education and professional development. The current pathways for STEM teacher certification at SFA include traditional undergraduate coursework in a face-to-face setting as well as a Master of Arts in teaching in an online setting. Students following the undergraduate pathway see an abundance of STEM content, while those on the master's track see none. Often the students on the master's track have an undergraduate degree in a STEM field, resulting in much of their master's work focusing on effective methods of teaching.

The proposed model is one of educator preparation focused on the content areas of mathematics and science as well as the teaching of math and science.

Approach and Assumptions Made

There are two main avenues through which the proposed program can have a measurable economic impact on the local area.[1] The first is the impact of newly trained and placed STEM teachers: these individuals will earn incomes while living and working in various parts of Texas, and their spending of that income will bring about the creation and support of other jobs, output and income. The second is the academic program on SFA's campus itself: new students recruited and enrolled in the program will mean additional Nacogdoches (or the surrounding area) residents, who will bring with them new spending on goods and services.

We begin by assessing the current conditions in the existing math and science education programs at SFA and make several assumptions about the likely future directions of the proposed initiative.

To date, there have been 22 graduates of the teacher certification pathways at SFA. Reportedly, all have either become educators or are on track to become educators (i.e., they are currently enrolled in advanced degree programs in education or mathematical sciences). Eighteen of the 22 (roughly 82%) are currently K-12 teachers in Texas. Specifically, eight graduates are employed by ISDs in the Dallas-Ft.Worth Metroplex and the surrounding area, two are in the Houston area, six are in Deep East Texas, and two are in Central Texas.

The proposed program's current goal is to graduate approximately 20 STEM teachers per year, though it may take some time for it to grow to this size. For the purposes of our estimates, we assume that the program has attained its full potential – i.e., there are 20 graduates every year. Next, we apply the same approximate proportions of regional placements as we observed for past graduates to future graduates to forecast the likely numbers of new STEM teachers in each region. Finally, we estimate the current average salaries of teachers in each area[2], which will be used in the economic impact determination.

It is worth stating clearly a number of other simplifying assumptions we have made up to this point:

[1]There are also significant nonpecuniary benefits to such a program; these are discussed in the last section of the report.
[2]This process is discussed in more detail below.

1. As the objective of the proposed program is to *increase* the number of STEM teachers in service, we are assuming that openings for these teachers will exist at various ISDs. In other words, the new placements are not simply replacements of retirements or departures but are actual net additions of STEM teachers.
2. We are assuming that the annual output of 20 graduates is a sustainable "steady-state" for this program at SFA: i.e., there is a sustained demand for it among students and a sustained demand for graduates on the part of Texas ISDs.
3. We are additionally assuming that the future placement of graduates will follow past placement patterns, at least in terms of regions within Texas. This may not be true if, for example, a rural area of the state becomes the main destination of new teachers because that is where they are most needed. Alternatively, it's also possible that an area quickly becomes "saturated" with teachers and simply does not have any additional needs. This is unlikely because math teachers experience a good deal of turnover, and therefore openings are likely to become available regularly.

Separately, we need to estimate the impact on the local economy in Nacogdoches of the additional students enrolled in the newly proposed program. Conservatively, we estimate that the typical annual residential enrollment in this program may be about 50 students.[3] According to JackFacts, SFA's summary of the student body composition, about 11.5 percent of students come from Nacogdoches county; conversely, 88.5 percent of enrolled students are from outside of the local area.

Applying the approximate proportion of ~90 percent of out-of-the-area-students and assuming that the program attracts all new students – i.e., no existing SFA students change their course of study to become STEM teachers – we estimate that the program will attract about 45 new students to be Nacogdoches residents.

Each of the 45 new SFA students is assumed to live in Nacogdoches for an average of three years while enrolled in the program. We estimate that each of these students spends about $17,308 locally per year on goods and services.[4]

Economic Impact Estimation

The following analysis estimates the economic benefits of the proposed STEM teacher preparation program using average teacher salaries by placement location and average spending for college students in a given academic year.

There are three main components of the analysis:

1. The direct effects of STEM program placements,
2. The indirect effects, and
3. The multiplier (or induced) effects.

The STEM Teacher program provides jobs and income to individuals graduating from SFA who are placed in new teaching positions across the state. That income from employment is directly created. Additionally, employment and income are generated indirectly when the students in the STEM Teacher program purchase goods and services from local or state service providers and vendors -– firms that in turn hire workers, earn profits, and generate income. Additional indirect impact occurs when some businesses increase their spending on intermediate goods as a results of new teachers' work.

[3] This allows for some attrition of enrollment throughout the year as well as some enrolled students completing the program online.

[4] See the Appendix for additional details on data sources and justification for these values.

The multiplier process results in the creation of additional income and employment as workers spend their incomes in the state and as other firms generate sales, earn profits, and hire new employees. To take direct effects and estimate total effects via this multiplier process, the analysis requires the use of Regional Input-Output Modeling System (RIMS II) multipliers, which are specific to Texas based on 2021 regional data that come from the U.S. Bureau of Economic Analysis (BEA).

Total output, earnings, and employment impacts of the STEM Teacher program are produced by aggregating the direct, indirect, and multiplier effects. Direct effects are attributed to the employment of recent STEM Teacher program graduates in the state (the direct employment impact) and payments to these workers (the direct income effect). Indirect effects result from students in the STEM Teacher program purchasing goods and services while they are in college and others increasing their spending as a result of new teachers' placement.[5] Finally, the multiplier effect occurs as the direct and indirect incomes are spent and re-spent within the state economy.

For example, individuals that graduate from SFA's STEM Teacher program are employed in Texas school systems. They spend a portion of their wages and salaries in the state on goods and services such as housing, clothing, and food. Likewise, the owners of businesses receiving these payments will use a portion of the proceeds to pay employees and earn profits, continuing the cycle.

Throughout each subsequent round of spending, a portion of the direct and indirect income leaks out of the state economy through taxes, payments to non-residents, savings, and spending outside of the state. As a result, additional impacts on the state economy and its residents are diminished.

Summary of Benefits — Texas

A total of $1.2 million is estimated to be paid directly to 20 SFA-trained STEM teachers in the form of payroll expenditures from various school districts across the state in a typical year. An additional $778.9 thousand was will be spent on direct non-payroll expenditures by students in the STEM teacher program. Examples include student spending on food, housing, transportation, clothing, accessories, furnishings, etc. After these expenditures are injected into the Texas economy, additional income and employment effects are generated via the indirect and multiplier processes discussed above.

Table1 summarizes the overall economic benefits of the SFA STEM Teacher program in Texas. The total impact is the combination of direct, indirect, and multiplier effects. As a result of the program, Texas state gross domestic product (SGDP) is estimated to increase by almost $3.6 million. The output multiplier, which is calculated by dividing the total output benefit by the direct spending on output, is 1.80. This suggests that for every dollar directly spent by students and graduates of the program in Texas, SGDP increased by $1.80.

Table 1: Annual Economic Benefits of SFA STEM Teacher Preparation Program in Texas

Impact	**Direct**	**Total**
Output	$1,976,919	$3,562,672
Earnings	$1,198,053	$2,271,314
Employment	20	47

Another important measure of economic benefits created by the STEM Teacher program is personal income or earnings, which includes wages, salaries, profits, interest, rents, and other forms of income earned by Texas residents. This measure is significant because it reflects gains that accrue directly to Texans.

[5] An example may be the school district purchasing additional computers to for new teachers' use or a local restaurant buying more food ingredients to satisfy new demand for meals.

Total income benefits from the STEM Teacher program equal around $2.3 million. The implicit multiplier associated with income benefits, calculated by dividing the total earnings benefit by direct spending on payroll, is 1.90, which indicates that for every dollar that program-trained educators earned in wages and salaries, $1.90 was created in total income in the state.

Lastly, the program will graduate 20 individuals in a typical year that will be employed by Texas school districts. An additional 27 jobs are created indirectly and through the multiplier effect. The implied employment multiplier is 2.37, suggesting that for every job directly filled by an SFA STEM Teacher program-trained person, a total of 2.37 jobs are supported in Texas.

It is also crucial to note that the program also offers fiscal benefits for the state government such as sales tax revenue, property tax revenue, business tax revenue, and payments-in-lieu-of-taxes. For example, newly employed program-trained educators pay taxes on their non-food items purchased at local stores.

Summary of Benefits -– Texas Regions

In this section, we explore the benefits of the SFA STEM Teacher program by Texas region. The Texas Comptroller's office separates Texas into 12 economic regions: Alamo, Capital, Central Texas, Gulf Coast, High Plains, Metroplex, Northwest, South Texas, Southeast, Upper East, Upper Rio Grande, and West Texas. Recent graduates of the STEM Teacher program accepted jobs located in four different regions in Texas – Capital, Gulf Coast, Metroplex, and Southeast.

The economic impact model and methods utilized here function the same way as in the case of the Texas statewide analysis described earlier. The key difference is associated with the RIMS II multipliers used to quantify the cumulative effect of total industry output, income, and employment that result from a change in final demand: here, regional multipliers are used.

The overall value of economic impact multipliers for regions tends to be smaller than statewide multipliers due to leakage. Leakages dissipate over all economic impacts. For example, the set of retailers where SFA STEM Teacher program-trained individuals were placed may be limited in that region. Thus, consumer spending will spill over to nearby metropolitan areas or through the Internet. As a result, there are significant leakages of spending that have little impact on a regional economy. Multipliers for bigger regions tend to be larger since there is less spending leakage. Thus, an economic impact analysis for the SFA STEM Teacher program for each region will generally capture smaller impacts than the statewide economic impact analysis.

The Southeast and Metroplex regions saw the highest total earnings and employment benefits as the majority of graduates are estimated to accept positions in Nacogdoches (Southeast region) and Dallas-Fort Worth (Metroplex region). Table 2 shows that a total of $826.5 thousand in earnings is produced in the Southeast region stemming from salaries paid to program graduates as well as spending they do as students while in the program. The next highest earning region was the Metroplex region with $810.0 thousand in total earnings, followed by the Gulf Coast and Capital regions, increasing earnings by $176.4 thousand and $166.7 thousand, respectively.

Table 2: Annual Economic Benefits of SFA STEM Teacher Program in Texas Regions

Region	**Total Earnings**	**Total Employment**
Capital	$166,706.10	3
Gulf Coast	$176,390.14	3
Metroplex	$810,009.40	15
Southeast	$826,497.82	20

Total employment benefits have a similar distribution across regions. The Southeast region employed 20 total individuals as a result of SFA STEM Teacher program graduates entering the workforce. Another 15 jobs were supported in the Metroplex region with the Gulf Coast and Capital regions supplying 3 additional people with employment each.

Conclusion

Stephen F. Austin State University's STEM Teacher Preparation program plays an important role in the state. Increases in output of goods and services, earnings, and employment are substantial and extend beyond the immediate benefits to those individuals directly employed after their program graduation. Indirect benefits arise from current program students' business and economic activity. They purchase from local businesses that in turn produce more output, employ additional workers, and pay additional wages. The multiplier effect occurs from additional spending of income earned through direct and indirect involvement with the SFA STEM Teacher program. Direct spending in Texas attributable to students and graduates of the program totals $2.0 million in output and $1.2 million in income, with 20 individuals directly employed. Once this money circulates through the state economy, it produces $3.6 million in output benefits, $2.3 million in earnings benefits to state residents, and employment for 47 individuals.

Nonpecuniary Benefits

In addition to the estimated economic impact of larger numbers of highly-qualified STEM teachers in various school districts around Texas, there are certain to be significant nonpecuniary benefits. By definition, these are nonmonetary societal gains – or at the very least, benefits that are difficult to quantify and value. Below, we discuss several of the possible ways, in which more and better trained STEM teachers can potentially bring about positive non-monetary benefits; we also survey the existing education literature on this subject to assess any evidence of these benefits.

The most direct and obvious potential benefit of having more qualified STEM teachers is better quality of instruction in mathematics (as well as science and technology) at middle- and high school levels. Whether this translates into better student learning of these subjects is an open question – and we examine some of this evidence in the next subsection – but there is certainly reason to believe that learning outcomes are *no worse* compared to the status quo. Better math learning has the potential to have substantial positive impacts; for example:

- Better performance on standardized tests, including college entrance exams (ACT, SAT)
- . . . Consequently better college admission outcomes (including better financial aid packages)
  - Note that this can include both, a higher probability of being admitted into any given school as well as better chances of admission into higher-ranked schools.
- Higher chances of students choosing STEM-related college majors and subsequently occupations, which tend to be higher paid

In addition to students benefiting directly by being taught by trained STEM teachers, there are often initiatives and opportunities such as STEM Camps, science and "mathlete" competitions that are possible through school districts with enough STEM educators. These programs often involve ISDs collaborating with higher education institutions, but high school teachers play a key role.

Going beyond immediate short-term benefits to student learning, longer-term positive aspects of high-quality STEM education can mean a better educated populace overall. Better understanding of mathematics, even at very basic levels, can have tremendous effects on society's well-being. These can include better informed voters, better decision-making consumers, more adept at facing financial decisions that affect them and their families (e.g., less likely to fall victims to financial scams), and so on.

Finally, there may be positive outcomes from a public policy point of view. Better math and science education can help improve the level of understanding and acceptance of scientific issues of social importance.

Existing Literature

After surveying some of the existing literature on the benefits of STEM education at middle- and high school levels in Texas, we conclude that better trained STEM teachers do have a positive impact on student outcomes. While the effect on standardized test performance is rather small (and often weak, statistically), it is almost always positive. Additionally, certain population groups appear to benefit more than others.

Much of the research has focused on comparing T-STEM Academies with non-STEM schools in terms of student learning of math and science and subsequent outcomes. Madden et al. (2016) find that in four of the five cases they examined, T-STEM Academies students performed better in math than students from non-STEM schools. It's worth noting that their measurement was the percentage of students meeting the satisfactory standard, not the student's score itself; they also find that the evidence was weaker or non-existent for other subjects, such as writing and social sciences.

This finding is confirmed by Bicer at al. (2015), who look at 18 T-STEM academies matched with 18 comparable non-STEM schools. They find that students who attended T-STEM academies performed significantly better in math compared to their peers at non-STEM campuses. Interestingly, female students in general attained higher scores than male students at the end of grade 9; however, at T-STEM academies female students performed worse even when compared to male students at non-STEM schools. Additionally, the study finds no significant difference in the *growth rate* of student scores from 2009 to 2011 based on which school they attended. It is possible, of course, that even careful matching of similar STEM/non-STEM pairs of schools does not address all of the inherent selection problems: students enrolled in the two kinds of schools are simply different.

Marder et al. (2020) perform a more direct comparison of "traditionally trained" STEM teachers (i.e., those with formal university credentials) to those classified as alternatively trained. Their conclusion is two-fold: 1) traditionally trained STEM teaches tend to stay in the classroom longer, and 2) gains in student performance in Algebra I over the period 2012-2018 were greater than gains in the performance of students taught by alternatively trained teachers. The size of the difference, however, is modest: 0.03-0.05 of a standard deviation. Similarly, Backes at al. (2018), who look specifically at the effectiveness of the UTeach program, find students do better on math and science end-of-course tests when they are taught by UTeach teachers: depending on the subject, the difference is eight to 15 percent of a standard deviation.

Finally, in a broader examination of inclusive STEM high schools (ISHSs), of which T-STEM academies is the largest cluster, Saw (2019) finds no impact on student test scores in either math or science when compared to students in non-STEM schools. However, other significant benefits emerge: "the effects are positive on completing advanced level math courses in high school" and "ISHSs [. . .] improve the rates of high school graduation for racial minority and low-income students."

Appendix

In this section, we provide a few additional technical details and sources of data that justify the values used as inputs into the economic impact estimates.

Dr. Jane Long and her staff provided us with a good deal of data on teacher salaries across many school districts. Unfortunately, in many cases, the data are not available or are incomplete; often, if there is not vacancy for a STEM teacher in the school district, the salary is not posted. Therefore, we supplement teacher salary data from the occupational database in Lightcast.

Specifically, we first aggregate individual districts' salaries by county. Then we compute a weighted average of the county salaries to form an "area" average salary. The weights are the current (as of February 2024) numbers of teacher jobs in each county.

We define each area as follows. For the DFW Metroplex, Houston area, and Central Texas, we use a radius of 50 miles from the center of each of Dallas, Harris, and Travis counties, respectively. For East Texas, we use the 12 counties designated as the Deep East Texas Council of Governments (DETCOG) area.

The resulting average area salaries are shown in Table **??**

Table 3: Weighted Average Area Teacher Salaries

Area	**Grads placed**	**Avg. Salary**
Dallas-Ft. Worth	9	$62,907
Houston	2	$63,928
East Texas	7	$54,364
Central Texas	2	$61,743

Salaries used are listed as salaries of "Secondary and Middle School teachers, except special ed," not strictly STEM teachers, which probably understates the true STEM teacher salaries in each area (STEM teachers often qualify for stipends in addition to regular salaries).

For spending by college students, we use estimates reported in a 2023 article by Grand Canyon University, available on their website. The following summarizes categories of goods and services and nationally representative amounts spent by college students locally:

Table 4: College Student Spending

Category	**Annual Spending**
Food	$6,564.00
Housing	$10,631.00
Transportation	$1,760.00
Clothing and Accessories	$158.98
Furnishings	$164.38
Electronics	$306.41
Miscellaneous	$83.56
TOTAL	$19,668.33

We adjust the total amount to reflect a cost-of-living (COL) difference, where Nacogdoches' composite COL index is approximately 88 (i.e., about 12 percent below the national COL index). The resulting approximate annual spending amount is $17,308.13.

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