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Innovative Education: Comparing the Success of STEM and Traditional School Models

Timothy Kennedy

A dissertation submitted in partial fulfillment

of the requirements for the degree of

Doctor of Education in School Improvement

School of Education

Christopher Thomas Ph.D. Committee Chair

College of Education and Psychology

The University of Texas at Tyler

Tyler, Texas

This is to certify that the Doctoral Dissertation of

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Innovative Education: Comparing the Success of STEM and Traditional School Models

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Dissertation Chair: Christopher Thomas, Ph.D.

The University of Texas at Tyler

May 2024

Abstract

INNOVATIVE EDUCATION: COMPARING THE SUCCESS OF STEM AND TRADTIONAL SCHOOL MODELS

Timothy Kennedy

Dissertation Chair: Christopher Thomas, Ph.D.

The University of Texas at Tyler

July 2024

This research study investigates the impacts of four specialized STEM education models—T-STEM (Texas Science, Technology, Engineering, and Mathematics), P-TECH (Pathways in Technology), Early College High Schools (ECHS), and New Tech Network schools (NTN) on student performance in Texas high schools. By analyzing aggregate student data collected by the state, this study compares the academic outcomes of students in these STEM-focused schools with those in traditional curriculum schools using ANCOVA (Analysis of Covariance) and Logistic Regression. The findings reveal mixed results: while some specialized STEM models show enhanced performance in STEM and other academic subjects, others do not consistently outperform traditional educational approaches. Additionally, the study explores the broader impacts on non-STEM subjects and overall student success, indicating that the effects of specialized STEM education are varied and context dependent. This research underscores the need for holistic approaches in evaluating educational models, highlighting the importance of balanced curricula that support comprehensive student outcomes. The implications for educational policy and practice are profound, suggesting that while STEM-focused models have potential, their implementation must be carefully assessed and adapted to meet diverse student

needs. This study contributes to the ongoing discourse on educational equity and excellence, providing insights that could shape the future of secondary education by informing evidence-based decision-making and the integration of cross-disciplinary strategies.

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Chapter 1: Introduction

United States School Accountability

Early attempts at standardized schooling in the United States included schools based on education in a particular subject, or general studies in a trade to produce functional individuals. These schools were typically limited to certain social classes, races, or genders (Cremin, 1974). There were no common education standards, as the curriculum revolved around what was needed in a particular geographic area. Parochial schools that were founded in early 18th century America focused on creation of educated parishioners or creating clergy. Colonists in the newly created United States first tried using traditional English methods of education, utilizing a combination of apprenticeship, church, community, and family to create functional individuals in society (Cremin, 1974). In the 1800's multiple states agreed that public education is a societal good, and advocated for taxpayer-funded schools, trained teachers, and compulsory attendance for students. Thus, school accountability and educational oversight have been topics of observation and debate since the 1830's (Reese, 2013). Eventually, the driving forces for the educational output in the United States were focused into two ideas. The first was that education of the populous was too important to be left to chance, and the second was that all youth needed formalized education (Perko & Cross, 2019). This idea of creating schools for a specific purpose has led numerous nations, including the United States, to research and construct new and innovative schools and school models.

Brown versus the Board of Education

Within the social fabric of the historical educational framework preceding the groundbreaking Brown v. Board of Education ruling, the United States grappled with a complex and convoluted system of racial segregation that intricately interwove a multitude of discriminatory statutes, policies, and practices. This interplay fostered a deeply rooted environment of systemic inequality but also underscored the challenges faced by marginalized communities in accessing quality education, that eventually demanded a transformative legal intervention (Cottrol et al., 2003). The decade after the Brown vs. Board of Education (Brown v. Board of Education, 1954) court ruling, the mindset surrounding the American educational system began to shift with an eye toward educating all students and no longer allowing for the significant gaps between minority students and white students in United States schools (Anderson, 2006).

Elementary and Secondary School Act and a Nation at Risk

The zeitgeist of the United States then led to the Elementary and Secondary School Act of 1965, codifying that disadvantaged and low socio-economic schools would be able to provide the same education as more affluent campuses and communities (Elementary and Secondary School Act, 1965).The passing of this act led to a need for measurement and accountability, to be able to identify if low socio-economic and disadvantaged students were achieving at the same level or improving to the same level as higher-income students marking the onset of educational accountability.

Emphasis on accountability continued through the 1980's with the Regan administration introducing the report *A Nation at Risk: The Imperative for Education Reform* (Gardner, 1983). The initial findings of the report informed the public that the United States' educational system was failing to prepare students to be members of a competitive workforce. In addition, the chief author of the report wrote that our society is being eroded by mediocrity that threatens our very future as a nation through the lackluster attempts at education (Harvey, 1983). President Ronald Regan upon learning the information contained in *A Nation at Risk* stated, "You've found that our educational system is in the grip of a crisis caused by low standards, lack of purpose, ineffective use of resources, and a failure to challenge students to push performance to the boundaries of individual ability—and that is to strive for excellence" (Regan, 1983, 1:59). The report contributed to the ideas that the American school system was failing and brought forward changes at all levels of educational content. The report created a movement in all states to increase rigor and expectations of student success. It suggested raising student standards, increasing testing to measure if students are progressing towards those standards, and a focus on improvement of curriculum available to teachers and students to support the previous two ideals.

Improving America's Schools Act and No Child Left Behind

The United States Congress in 1994 continued its focus on educational accountability with a rewriting of the Elementary and Secondary Education Act. The focus of the Improving America's Schools Act (1994) was to increase academic rigor in reading and mathematics by mandating every state to set academic standards for these subjects. The subjects were to be evaluated in at least three grade levels as well as making disaggregated data available for student populations, especially English language learners or socio-economically disadvantaged (Heck, 2004). Many states did not show urgency in adopting new standards, and some did not have systems in place until the No Child Left Behind Act of 2001 (Goertz & Duffy, 2003).

The introduction of the No Child Left Behind Act of 2001 (NCLB) created a federal mandate to increase school accountability. One of the largest features of NCLB was that each state developed and adopted a performance-based accountability system, usually based on standardized tests that began in grade three and continued through high school. The accountability assessments focus on students' content knowledge in the domains of science, math, and English language arts. NCLB was developed to hold campuses and districts accountable for student performance and mandated that results of tests be available to the public (No Child Left Behind Act, 2002). This information was and is still used to inform parental choice between campuses. The given theory of action behind the creation of accountability ratings and mandated standardized testing is that accountability would force the improvement of educational outcomes of students, teachers, and campuses (Heilig & Darling-Hammond, 2008).

Focusing on continued accountability continued with the No Child Left Behind Act (NCLB). Under the No Child Left Behind Act, students in grades 3 through 8 must be assessed for reading and math performance annually. An additional reading and one math test were required during high school (Klein, 2023). Before the NCLB, annual progress exams were not required as part of accountability for students and districts. The reporting standards of the Improving America's School act was kept with a new mandate to make this data understandable to non-academics. Data was typically collected in elementary, middle, and high school, and NCLB made suggestions on readability for parents and business leaders, to facilitate understanding if the local and state school systems were making progress. While some states lauded the new features of the NCLB, others argued with the rigidness of the new system. By 2005, many states were allowed waivers and other measures of flexibility (Dee & Jacob, 2010). Added flexibilities included alternative measures of managing student progress as well as other methods for measuring progress of disadvantaged and disabled students (Sawchuk, 2022).

Under the NCLB, campuses required students to perform under a mechanism called Adequate Yearly Progress (AYP). If a campus has missed its achievement target for 2 or more years, the campus would be subject to sanctions that would increase in severity (Dee & Jacob, 2010). The sanctions included transfer of students to a new campus in the district, tutoring classes for students, or in severe cases, state education boards could choose to intervene and take over the campus to turn the school around and return it to making adequate progress. A failure to meet achievement criteria at the school, campus, or district level could lead to severe consequences for district administrators and school boards. Schools could suffer financial sanctions, such as a loss of funding or additional oversight from state governing bodies. The school may suffer public outcry from parents and community leaders because results would be published for every level of the district and compared against other schools in the area. In extreme cases, the district's students could be given the opportunity to move to a better performing school, thus causing academic culture loss, funding loss and job security issues among teachers and admin at the underperforming school. This process was implemented during a five-year rolling timeline if a school underperformed (United States Department of Education, 2002, as cited in Dean, 2016).

Every Student Succeeds Act

The United States' current educational doctrine is The Every Student Succeeds Act of 2015 (ESSA). The ESSA still retains the annual standardized testing requirements under the 2001 NCLB act but has moved the accountability system to the states instead of federal oversight. Testing goals and struggling campus informatics after ESSA now are controlled by the state of interest. These testing goals are now managed internally via district or state interventions, and no longer involve the federal government (Erwin et al., 2021). Students continue to take an annual test between third grade and eighth grade, with additional testing for subject areas in 9th through 11th. Additional requirements for the ESSA accountability system include growth measurement for reading and math assessments, proficiency measures for English, academic growth measurement in grade and middle school, and a measure of school quality with many states using absenteeism as their final indicator (Klein, 2023). ESSA empowered each state to adopt their own accountability measures and systems based on existing or redesigned academic standards, including standardized tests, as well as creating a system that reports the long-term goals of students regardless of race or subgroup the student belongs to (Klein, 2023).

Failure to meet targets for underperforming districts are currently more relaxed than those under NCLB. States must be able to identify their lowest performing 5 percent Title I schools in the state, as well as high schools that have graduation rates below 67 percent. States must also identify schools in need of targeted support and improvement, but the interventions for these categories can be chosen by the states or districts using evidence-based practices, instead of the highly prescribed methods of NCLB (Darling-Hammond et al., 2016). ESSA also allows and encourages the use of external stakeholders in the discussion for practices that will improve the outcomes for their specific schools and campuses.

Texas Accountability Measures

The Texas Education Agency is the principal governmental actor responsible for overseeing educational efforts for public primary and secondary schooling in Texas (Texas Education Agency, 2022). As of 2024, the Texas Education Agency was responsible for over 1200 individual school districts and charters in the state (TEA, 2023). The TEA, however, does not mandate or have oversight over parochial or private schools in the state, whether they are accredited or not. The TEA also does not have oversight over homeschooling efforts in the state (TEA, 2023).

School districts in the state of Texas are independent entities, but the Texas Education Agency oversees the districts operations, and can suggest or force corrective action based on issues that may arise. Issues can include the State Assessment of Academic Readiness (STAAR), performance at the campus or district level, or mismanagement of campuses or districts. Action can include conservatorship, action plans and regular status reports, or in extreme issues, closure of a campus or district (TEA, 2023)

In addition to oversight on educational content, the TEA oversees financial accountability through the School Financial Integrity Rating System of Texas and can assign accreditation statuses to districts throughout the state. The Texas Legislature gave the TEA the rights via statute in 1993 to rate districts and campuses though a universal accountability system (T. The state currently posts information about campus including, performance reports, school report cards and more on publicly accessible websites through the Texas Performance Reporting System (TPRS) contained within Texas Academic Performance Reports (TAPR; TEA, 2024).

The Texas Academic Performance Reports contain information on state accountability domains and how a campus or district rates versus a benchmark score. These domains include the following: college, career, and military readiness (CCMR), student progress, economically disadvantaged percentage, Advanced Placement (AP) college equivalency classes, International Baccalaureate (IB) results, SAT/ACT results, advanced course/dual enrollment completion, English language proficiency, attendance rate, and profile information on students, programs, and staff (TEA, 2019). The state of Texas determines if a campus meets (CCMR) by a combination of college entrance exams, such as the Texas version of the Accuplacer test by the College board, coursework towards an industry recognized certification, or enlistment in the military after graduation (TEA, 2019).

Academic Grade Rating

Currently, Texas uses a 3-category process for determining the letter grade rating for a campus. First, a campus is given a student achievement score, based out of one hundred points, with letter grades representing 10-point differences. This score is comprised of components of the campus STAAR scores, the campus's college, career, and military readiness (CCMR) measures, and graduation rates (Texas on Course, 2021). In addition, there is a school progress component, also rated on a 0-100 scale, with latter grades using the same metric as student achievement scores. This score is calculated using campus STAAR scores and college, career, and military readiness (CCMR) scores. High school campuses can take the higher score of the two domains between Student Achievement and School Progress (Texas on Course, 2021). Finally, schools are also rated on their closing the gaps score, or how well a campus has addressed needs within their student performance or other indicators. This score is also based on a 0-100 scale score and is calculated from federal graduation measures for the campus, growth performance in English Language Arts and mathematics for students, and English Language Proficiency as measured by the Texas English language proficiency assessment system (TELPAS) (Texas on Course, 2021).

To calculate the overall score of a campus, the domain that has the higher score out of student achievement and school progress is weighted by 70% of the final rating, with closing the gaps being weighted at 30% for a full 100% weight. The score is then rounded up to determine the overall rating of a campus or district. This information can be found on the Texas Education Agencies numerous websites, or as released data to the district called the Texas Academic Performance Reports, or (TAPR) (TEA, 2023).

In addition to the information contained in the Texas Academic Performance Reports (TAPR), campuses and districts can also achieve additional recognition with designations of distinctions. Awarding of a distinction shows that a campus or district has achieved beyond the standard metrics in one of numerous performance indicators. A distinction designation shows a campus has had exceptional performance relative to a comparison group of campuses. These campuses are similar demographically and can be based on size, type of school, number of grades, and student socio-economic makeup. Campuses and districts awarded accountability ratings of A, B, C, or D are eligible to earn distinctions. Distinctions can be awarded in the following areas: academic achievement in English language arts/reading, mathematics, science, Social Studies, top 25 percent: comparative academic growth, top 25 percent: comparative closing the gaps, and postsecondary readiness (TEA, 2019).

Leadership in STEM

According to Friends of Texas Public Schools (2024), Texas campuses lead the nation with the largest enrollment growth in STEM programs across the United States. 233,000 Texas high school students were enrolled in Career and Technical Education (CTE) classes specifically focused on STEM fields in the 2020-2021 school year. Texas Education Agency reports that during the 2019-2020 school year, 84% of Texas public high school students took at least one math course beyond Algebra II, while 56% of students pursued at least one science course beyond biology (Friends of Texas Public Schools, 2024). Texas school districts are home to many STEM-focused schools and academies with specific focuses and innovative learning environments that elevate the potential of Texas students interested in STEM disciplines (TEA, 2020). Some of these school models of interest are listed in the next few sections.

School Model Descriptions

Early College High Schools (ECHS) offer open-enrollment high school programs that provide college opportunities for students that are underserved, at-risk, and economically disadvantaged to attend college. Students can earn a high school diploma and an associate degree or up to sixty credit hours toward a bachelor's degree. Partnerships with higher education institutions enhance college readiness and reduce access barriers, with 65,000 students served across 182 schools as of the 2019-2020 school year (TEA, 2023)

Pathways in Technology Early College High Schools (P-TECH) combine high school education with college or post-secondary courses, such as industry certification or training. P-TECH focuses on career readiness, with a focus on underserved, at-risk, and economically disadvantaged students. Apprenticeship and internship are large components of the model in collaboration with Texas higher education institutions and regional businesses. Texas has 108 P-TECH schools as of the 2019-2020 year, with plans to add more, aligning with regional workforce needs for high-demand careers (TEA, 2023).

Texas Science Technology Engineering and Mathematics (T-STEM) Academies are open-enrollment schools aimed at improving student performance in STEM subjects. T-STEM schools target underserved, at-risk, and economically disadvantaged students, offering dual credit courses at no cost. The program provides rigorous instruction, real-world problem-solving experiences, and academic support services. T-STEM engages stakeholders, including industry and higher education institutions, to prepare students for STEM careers, with ninety-five academies designated as of the 2019 school year and a blueprint to create more in the future (TEA, 2023).

The New Tech Network (NTN) School Model emphasizes project-based learning, collaboration, and technology integration. Students engage in real-world projects that foster critical thinking and problem-solving across multiple disciplines. NTN schools prioritize collaboration among students, teachers, and the community, with teachers acting as facilitators. Assessments are based on students' application of knowledge and collaborative skills, while personalized learning addresses individual student needs. NTN includes over two hundred schools nationally, with a significant presence in Texas (New Tech Network, 2024).

Academic Performance in STEM Model Schools versus Public Schools

School models, including charter schools, aim to bring fresh ideas and innovative teaching methods to education compared to traditional public schools (Schneider, 1999). There is a wealth of research on how these different models affect student outcomes, but there is no clear consensus. Many scholars focus on factors like student grouping practices and how school choice can introduce bias, with a particular emphasis on ability grouping's effects (Berends, 2015; Berends & Donaldson, 2016).

Studies on STEM-focused charter schools show promise. Betts and Tang (2014) found that students in these schools made greater gains in math compared to public schools. However, there was not a significant difference in reading achievement between the two groups. Zimmer et al. (2009) also found no overall performance difference between STEM charters and public schools. Betts and Tang's (2014) further research revealed that achievement gains in charter schools varied by location. Specifically, schools in New York City and Boston saw more improvement compared to those in other areas. Additionally, their findings showed that gains in middle school reading, and high school math were not statistically significant.

Results in Texas paint a mixed picture. In 2019, the state saw variations in overall STAAR passing rates by subject and school type (TEA, 2020). There were gains in reading, with standard charters exceeding traditional districts. However, math, science, and social studies scores lagged in charters. Writing showed no significant difference between standard charters and public districts, with both achieving similar passing rates. Overall, passing rates between these two groups differed by three percentage points or less in each subject area. Looking at

Texas and Florida, Greene and Winters (2003) reported that charter school students outperformed their public-school counterparts. In Texas, charter school students scored 0.18 standard deviations higher than public school students in reading and 0.19 higher in math. Interestingly, the impact was larger in urban areas, which aligns with the geographic placement patterns of charter schools in most states.

Theory of Change

School improvement science, as described by Bryk and colleagues (2010), is an approach focused on understanding and solving complex educational problems through disciplined inquiry and continuous improvement processes. School improvement as a theory of change involves a strategic and systematic approach to transforming educational environments to enhance student outcomes and overall school performance (Bryk et al., 2010). According to Fullan (2006), effective school improvement requires identifying key areas for process enhancement, such as quality teachers, relevance in curriculum, engagement of students, and the allocation of limited resources. This iterative process involves implementing evidence-based practices, fostering collaboration, and adapting to emerging educational challenges and opportunities (Bryk et al., 2010). Research into Professional Learning Communities (PLCs), a core value of improvement science, can foster collaboration among teachers and build better teaching outcomes (DuFour et al., 2016). By integrating professional development for teachers, fostering community partnerships, and leveraging data for informed decision-making, schools can build a resilient framework for sustained growth. Competency-Based education is also one of the pillars of school improvement, with direct implications for campus success in standardized testing. Students that progress on mastery of content instead of time spent shows a personalization in learning that leads to higher student achievement (Sturgis & Patrick, 2010). Ultimately, the theory of change in school improvement is about transforming schools into dynamic learning communities where every student has the opportunity to thrive and reach their full potential (Hargreaves & Fullan, 2012).

Purpose of Study and Research Hypothesis

The current body of literature does not adequately address if STEM based school models outperform other campuses, and there are questions about the methods that the state of Texas uses in terms of fairness to all campuses. The state currently judges schools based on their accountability records (TEA 2020, 2022,2023). These ratings are based on a combination of graduation rates, college, career, and military readiness outcomes, and state standardized tests, such as STAAR and in the past TEKS, TAAS, and TEAMS. These data points, however, can be more refined with the inclusion of distinction data. “A distinction designation acknowledges districts and campuses for outstanding achievement based on the outcomes of several performance indicators (TEA, 2019).

This research study's purpose is to gain additional methods of differentiation between public schools and various models of school or charter school in Texas. The state of Texas provides student, campus, and district data every year to the general populous of Texas, and I intend to use this provided data in a new, novel way to show additional comparisons between demographically similar schools.

Research Questions

Through this research, I intend to answer questions about school education in Texas.

1. Do distinct types of STEM school models such as T-STEM blueprint schools, New Tech Network Schools, P-TECH, and Early College High Schools outperform standard curriculum-based schools in terms of overall campus rating when controlled for numbers

of students, percent of economically disadvantaged students and number or English Language learners?

2. Do distinct types of STEM school models such as T-STEM blueprint schools, New Tech Network Schools, P-TECH, and Early College High Schools receive more distinctions than standard curriculum-based schools after controlling for numbers of students, percent of economically students disadvantaged and number or English Language learners?
3. Can variables such as school type, number of students, percentage of economically disadvantaged students or percentage of emergent bilinguals determine if a school has a higher probability of receiving a distinction given by the state in Academic Achievement in English Language Arts/Reading, Academic Achievement in Mathematics, Academic Achievement in Science, Academic Achievement in Social Studies, Top 25 Percent: Comparative Academic Growth, Top 25 Percent: Comparative Closing the Gaps, or Postsecondary Readiness?

My Hypothesis after consulting the literature is that STEM school models will produce statistical gains in science and mathematics, but do not show any difference for other subject areas, or that the difference in not statistically significant. Additionally, other school variables, such as the number of students and the socio-economic status of the campus will influence the overall campus score as well as the number of distinctions that a campus earns. Finally, different school models will show statistical differences in achieving distinction awards versus other models or the standard school model.

Research Plan

To conduct this study, I identified a lack of current knowledge in differentiation of school models (i.e., does certain STEM model campuses outperform standard school models in state standard assessments). The literature review in this study confirmed that ideas are mixed on if STEM based models perform better overall versus other school models. Some research showed high student achievement scores in academic testing, while others showed that the increases were either not statistically relevant or were statistically worse in other subjects. I relied on public datasets released by the state of Texas that contained campus and district overall scores, campus identification numbers, demographic percentages, and distinction awards. A correlational research design using ANCOVA, and logistic regressions was selected to determine if a relationship exists between STEM school models and overall campus scores or distinction awards.

Significance of this Study

This study comparing Early College High Schools (ECHS), Pathways in Technology Early College High Schools (P-TECH), Texas Science Technology Engineering and Mathematics (T-STEM) Academies, and the New Tech Network (NTN) School Model provides insights into campus educational policy, campus curriculum, and student outcomes. I hope to inform policymakers at multiple levels on how resource allocation and the adoption of best practices can help determine the best educational models for their students and campuses. Understanding the comparative effectiveness of these models will tell which educational models most effectively support academic achievement, college readiness, and career success, especially when looking through the lens of at-risk and economically disadvantaged students. Furthermore, the study will highlight the role of community and industry partnerships in education, enhancing student success and providing regional workforces targeted support.

Finally, the study would drive continuous improvement and innovation in education by providing data-driven insights for refining programs and strategies. The evaluation of students across different models will allow educators to design more effective and appealing learning environments. The comparative study of these school models will contribute to educational understanding and close achievement gaps and promote better outcomes for all students.

Assumptions and Limitations

This research assumes that the data collected by the state of Texas regarding school models was valid and correctly aggregated, analyzed and reported. It is assumed that no district was coerced in how their data was recorded or reported, and all data presented was truthful and not manipulated. Several limitations should also be acknowledged in this study. Firstly, its correlational design limits the ability to establish causality between school model and academic performance. The generalizability of the findings may be limited to the specific study region, the state of Texas, and focusing only on high school campuses (grades 9-12) as identified by the state. Additionally, reliance on secondary data sources, which the researcher could not manipulate, may introduce biases or measurement errors, leaving questions about the dataset's validity. The absence of demographic covariates further limits the analysis. Moreover, this does not include qualitative methods, which could enhance the validity and depth of the findings.

Chapter 2: Literature Review

This literature review examines the state of school accountability over approximately 50 years, with detail given to major changes in educational accountability from new landmark pieces of educational law and theory. The review then shifts into an examination of various STEM (Science, Technology, Engineering, Mathematics) school models and their effectiveness versus traditional methods in terms of student growth and achievement when described by state standardized testing. Discussion about the information presented and the proposal for study will finish this chapter.

Methods for Conducting the Literature Review

To begin this review on national and state accountability, research was conducted using the online materials and resources of the Robert R. Muntz Library at the University of Texas at Tyler (UT Tyler) from August of 2019 to August of 2023. Specifically, the library SwoopSearch feature was used to research keywords and phrases including “educational accountability,” “educational accountability in the state of Texas”, “state versus local versus national accountability”, “School Models”, “School Models in the state of Texas”, “vetted school models in the state of Texas”, and “STAAR testing accountability and outcomes”. Information requested about charter schools using SwoopSearch included the search terms “T-STEM schools and their effectiveness,” T-STEM Blueprint Schools, “P-TECH schools’ effectiveness in Texas,” “Effectiveness of STEM based school models,” and “New Tech Network Schools effectiveness in Texas. Additional searches consisted of materials released by the Texas Education Agency (TEA) regarding accountability standards and how districts would be affected by new standards. Work from peer reviewed academic journals, trade publications, district accountability documents and books were also consulted and used when data or findings were appropriate and relevant. Additionally, research was conducted using Google Scholar using the search terms "educational accountability", "accountability in the state of Texas", "state versus local versus national accountability", "STAAR testing accountability and outcomes", "longitudinal school model studies", "school models", "type of school models", and "state supported school models Texas". Additional literature was requested from Google Scholar regarding T-STEM, P-Tech, and New Tech Network schools and their effectiveness versus standard school models, which gave additional pieces of limited literature.

Data was collected and sorted using the Microsoft Office suite of tools, and the online Google Office suite of tools. Data was also organized using traditional pen and paper methods, that was then photographed and scanned into one of the before mentioned software products.

Educational Accountability

Focus on accountability is not a unique idea to education policy, but a cornerstone in many governments around the world (Bovens, 2007; Dubnick, 2014; Gorur, 2017; Stensaker et al., 2011). Research in accountability increased greatly between 1965 and 2000 (Dubnick, 2014) with many countries creating new urgency about accountability and their educational place on the world stage. In the United States however, educational policy was non-existent at the national level, and was left to local and state control, as the constitution did not specifically enumerate educational oversight (United States Department of Education, 2024).

This focus changed after the Supreme Court's ruling in *Brown v. Board of Education of Topeka*, 347 U.S. 483 (1954) stating the importance of equal educational opportunity no matter the race or creed of the student. The resistance of many state and local entities to desegregate and to provide equality to students of all races shifted the United States towards central educational policy (Delmont, 2016; Seraus-Roache, 2019). The early failures of the space race of the 1950's and 1960’s to the Soviet Union along with continued racial tension and oversight led numerous congresses and presidents to continue to advocate for educational accountability. Sociologist James Coleman created the Equality of Educational Opportunity report which detained vast racial and socioeconomic inequality in the United States further strengthening the focus on the divide between the United States and other developed nations (Coleman, 1965). This with rising tensions from the Civil Rights Movement led to one of the first sweeping educational accountability measures in the history of the United States the Elementary and Secondary Schools Act of 1965 (ESEA). The passing of the Elementary and Secondary Schools act led to the creation of an accountability system to identify if low socio-economic and disadvantaged students were achieving at the same level or improving to the same level as higher-income students (Guthrie, 1968).

When President Regan and his education task force released “*A Nation at Risk: The Imperative for Educational Reform"* (The National Commission on Excellence in Education, 1983), the conversation was clear that the United States needed to move towards more rigorous standards and accountability so that “our nation could continue to be a productive world leader” (Squires, 2005, p. 49). The chief author of the report stated that the foundations of education in the United States were being destroyed as mediocrity took over (The National Commission on Excellence in Education, 1983). Even before this time however, the federal government represented by both political parties had shown a desire to increase federal standards and accountability so that the United States can preserve its status as the highest-regarded economy and educational system (Runde et al., 2023).

Measures of accountability were further encouraged by President George W. Bush with the passage of the No Child Left Behind Act (NCLB) in 2001 by providing economic incentives for schools to increase performance on state standardized tests with the goal of increasing quality education for all American children. Then in 2010, President Barack Obama proposed reauthorizing the Elementary and Secondary Education Act to compete economically with other countries, arguing a collective education effort must be made to turn around our education system to compete on a global economic scale (United States Department of Education, 2010).

Measured school reform is unlikely to occur due to imposed standards on school systems, which aim to increase student achievement. Few studies have explored whether the models used for evaluation and improvement, along with the necessary support from schools, districts, and state agencies, effectively enhance instruction for underperforming teachers rather than merely holding them accountable for low academic performance (McGuinn, 2011). Many studies instead focus on the conditions present in high-functioning schools and districts, examining how these can inform policy decisions. Revamped teacher evaluation systems often emphasize increased accountability by incorporating student test scores into overall teacher evaluations (Donaldson, 2012; Close, Amrein-Beardsley & Collins, 2020). However, research has shown that interventions often fail to create the necessary support systems for driving professional development and building capacity within state and local school systems. Measures intended to improve teaching effectiveness sometimes do not lead to improvements in student outcomes, particularly among low socio-economic students (Stecher et al., 2018). To truly enhance student achievement through reform efforts, instructional practices of teachers must improve, requiring continual improvement efforts, resources, and strategies to combat teacher resistance to change (Lewis et al., 2011). Comprehensive evaluations of principals and teachers that include student achievement metrics and campus surveys can lead to significant positive effects in academic subjects by fostering campus buy-in (Hanushek et al., 2023).

Considering these challenges, exploring alternative school models becomes crucial. One such model is the STEM (Science, Technology, Engineering, and Mathematics) school model, which offers a distinct approach to education aimed at addressing some of these persistent issues in traditional school settings. By examining the differentiation between STEM school models and standard models, we can better understand their potential impact on student achievement and instructional practices.

Promotion of STEM Focused Education and STEM School Models

For over 20 years, the importance of educating students in Science, Technology, Engineering and Mathematics has been discussed not only in the United States, but nearly all other developed countries in the world (National Science Board, 2016, as cited in Roberts et. al., 2018). Society has recognized that everyone will require some combination of training in our technology driven future, and Science, Technology, Engineering and Mathematics (STEM) education presents a successful pathway for us to educate all our population, not just those interested in becoming professionals in STEM fields (Pew, 2017). Research conducted by the National Science Board found that including workers of all educational backgrounds, the STEM associated workforce of the United States was 23% of the total workforce in 2019 (Okrent & Burke, 2021). Leading researchers agree that without forming a culture that promotes Science, Technology, Engineering, and Mathematics, individuals and groups will not be able to compete in a global economic system (Esin, 2018). Education true to STEM ideas should increase critical thinking, problem-solving, and improvement of technology skills (Bybee, 2010).

STEM Focused School Model Descriptions

Early College High Schools (ECHS) in the state of Texas are open-enrollment high schools that focus on college opportunities for students least likely to attend college. These campuses allow students to achieve a high school diploma and either an associate degree or at least sixty credit hours toward a baccalaureate degree. Early College High Schools typically enroll underserved students with a target of at-risk and economically disadvantaged students. Dual credit classes are offered at no cost to students and include accelerated programs and rigorous instruction. Support systems, social and academic, are offered to students to ensure their success in ECHS. Students also receive personalized attention and are provided increase college readiness, complete with partnerships among Texas higher education institutions to reduce access barriers for these students. According to the Texas Education Agency "The ECHS Blueprint Provides foundational principles and standards for innovative partnerships with colleges and universities. Additionally, outcome-based measures in Access, Attainment, and Achievement provide guidance for ECHS program implementation and continuous improvement efforts" (TEA 2024). 65,000 students are served by Early College High Schools as of school year 2019-2020, comprising of 182 designated ECHS, with additional in planning stages (Texas Education Agency, 2023b).

Pathways in Technology Early College High Schools (P-TECH) offer students the opportunity to earn a high school diploma and an associate degree or industry credential simultaneously during their high school years. These schools emphasize career readiness and work-based learning opportunities. According to the Texas Education Agency, P-TECH programs are designed to engage historically underserved students, specifically targeting at-risk and economically disadvantaged populations. They provide students in grades 9 through 12 the chance to complete a combined high school and post-secondary course of study (TEA, 2023b). Additionally, they can obtain Level 1 or Level 2 certifications, or other industry-based credentials, within six years. The P-TECH model includes age-appropriate work-based learning experiences at each grade level, allowing students to gain practical work experience through internships, apprenticeships, or job training programs. These schools' partner with Texas higher education institutions and regional businesses, facilitating access to post-secondary education and workforce training. P-TECH also focuses on aligning with regional workforce demands, preparing students for high-demand, high-wage careers (TEA, 2023b). As of the 2023 academic year, Texas has 108 P-TECH schools, with plans to add approximately twenty more schools every 3-5 years. The Texas Education Agency will revise the P-TECH blueprint annually with input from communities and stakeholders.

Texas Science, Technology, Engineering, and Mathematics (T-STEM) Academies are open enrollment charters and secondary schools focused on enhancing student achievement in science and mathematics. The primary goal of T-STEM schools is to prepare and increase the number of students entering STEM fields in Texas and beyond. According to the Texas Education Agency, T-STEM schools and programs enroll historically underserved students, specifically targeting at-risk and economically disadvantaged populations, while providing dual credit at no cost to students through local higher education institutions. These academies aim to improve STEM instruction and academic performance by engaging students in innovative and problem-solving activities within real-world contexts. The T-STEM model offers rigorous instruction and accelerated courses to increase college readiness. It also provides academic and social support services to help students succeed (TEA, 2023b).

By engaging stakeholders, including industry and colleges, T-STEM schools and the state-created blueprint strive to develop the workforce of tomorrow. In addition to enhancing STEM education, T-STEM academies promote critical thinking, collaboration, and practical application of knowledge, equipping students with skills necessary for the future job market.

During the 2019 school year, the state of Texas designated 95 T-STEM academies (TEA, 2023b). These academies are part of a broader effort to address the growing demand for STEM professionals and to ensure that students from diverse backgrounds have the opportunity to pursue careers in these high-demand fields. The success of T-STEM academies reflects a commitment to educational equity and excellence, fostering a pipeline of skilled individuals ready to contribute to the state's economic and technological advancements.

The New Tech Network (NTN) School Model is an educational approach that emphasizes project-based learning, collaboration, and the integration of technology into the classroom. The central idea behind the New Tech Network model is the belief that students learn best when engaged in real-world projects requiring critical thinking, problem-solving, and teamwork. The NTN school model consists of the five major components listed below (New Tech Network, 2024). First, Project-Based Learning (PBL**)** allows students to work on projects designed to mimic real-world challenges. These projects often involve interdisciplinary topics, requiring students to apply knowledge and skills from multiple subject areas. Second, Technology is woven into all aspects of teaching and learning in NTN schools. This includes using digital tools for research, collaboration, and presentation, ensuring that students are adept at using and understanding these tools. Third, NTN schools prioritize collaboration among students, teachers, and the broader community. Teachers act as facilitators and guides rather than traditional lecturers, fostering a collaborative learning environment (Bergeron et al., 2019). Fourth, Assessment in NTN schools go beyond traditional tests and quizzes. Students are evaluated based on their ability to apply knowledge and skills to real-world problems and their proficiency in communication and collaboration (Gordon and Bergeron, 2018; Stocks et al., 2019). Finally, New Tech Network schools also recognize that each student is unique with different strengths, interests, and learning styles, and the NTN model strives to personalize instruction (Hinnant-Crawford & Virtue, 2019). Teachers provide support and enrichment tailored to meet individual students' needs.

The New Tech Network lists over two hundred schools in their national system, with many located in Texas. Recently, the New Tech Network school model was selected as a vetted improvement program, offering contracted services in effective instruction as described in the Effective Schools Framework (TEA, 2023b). This recognition underscores the model's effectiveness in promoting student engagement, collaboration, and real-world application of skills, making it a significant contributor to educational reform and improvement.

STEM versus Traditional School Models

Research has consistently demonstrated that students in STEM-focused curricula experience statistically significant improvements in some areas academically, but trail or perform at even levels with other school models. (Means et al., 2016). Young et al., (2011, 2016), conducted a comparative analysis of ninth-grade students enrolled in inclusive STEM versus traditional schools, revealing that those from inclusive STEM schools showed slight improvements in high-stakes mathematics tests. Additionally, these students were 1.8 times more likely to meet proficiency standards for reading and mathematics assessments and 0.8 times less likely to be absent from school. Furthermore, tenth-grade students in inclusive STEM schools outperformed their peers on mathematics and science high-stakes exams, being one and a half times more likely to meet proficiency standards in reading, mathematics, science, and history.

The effectiveness of STEM-integrated learning models is further supported by a meta-analysis of the Technology Pedagogical Content Knowledge (TPACK) model. Zulkifli et al. (2022) analyzed international and national journals, concluding that STEM-integrated TPACK learning significantly improves 21st-century skills in high school students. The analysis revealed effect size values of 1.765, with an N-Gain of 0.56 and an SD value of 0.29, indicating the model's effectiveness in high school biology education. This meta-analysis emphasizes that integrating technology with pedagogy and content knowledge not only enhances students' understanding of biological concepts but also prepares them for future academic challenges and careers in STEM fields. Different methods of STEM instruction have been shown to have positive outcomes among elementary, middle school, and informal science experiences (Brophy et al., 2008, as cited in Estapa & Tank, 2017). Informal classroom sessions exposing STEM ideas not only engage students in off-cycle times, preventing "summer slide," but have been shown to have a positive effect in influencing STEM attitudes (Donmez, 2021). Another promising approach in STEM based instructional practices is the use of an integrated STEM curriculum that crosscuts in multiple subjects, bringing relevant experiences to learners in all subjects (Furner & Kumar, 2007).

T-STEM schools have shown encouraging outcomes regarding graduation and dropout rates. Oner et al., (2016) found that institutions emphasizing college and STEM readiness had higher graduation rates and lower dropout rates compared to traditional public schools. The rigorous academic curriculum and personalized learning environments in T-STEM and college preparatory schools significantly contribute to student retention and successful high school completion. These schools often provide tailored support and resources, fostering an environment where students are motivated to achieve their academic and career goals.

P-TECH schools in New York City have also demonstrated positive effects on student outcomes. Research by Rosen et al. (2020) indicated that P-TECH schools lead to higher enrollment in dual credit classes and better performance among eighth graders starting with weaker academic levels. The Texas Education Agency (2020) highlights that P-TECH schools focus on age-appropriate learning experiences and prioritize enrolling historically underserved students, including at-risk and economically disadvantaged students. This model's success underscores the importance of providing equitable access to high-quality education, particularly for students who might otherwise be left behind.

Existing studies show a trend of superior performance among students in STEM based schools, particularly in STEM subjects such as mathematics, science, and computer science. This underscores the effectiveness of STEM-focused school models in equipping students with the skills necessary for future STEM-related careers (Hanushek et al., 2023). However, the literature also highlights significant gaps in our understanding of these models' broader impacts on student growth and success. Research by McGuinn (2011) and Stecher et al. (2018) suggests that targeted interventions and evaluation systems may help boost STEM outcomes, they do not necessarily translate into improved performance in non-STEM subjects like history and reading. In addition, Donaldson (2012) and Close, Amrein-Beardsley, and Collins (2020) indicate that accountability measures focused on test scores often neglect the holistic development of students, including their overall academic achievement and preparedness for careers or military service. As Lewis et al. (2011) emphasize, ongoing support, professional development, and the willingness to adapt instructional practices are crucial for sustaining improvements across all subject areas. Therefore, future research should aim to fill these gaps, providing a more comprehensive understanding of how STEM education impacts student success beyond STEM disciplines.

Chapter 3: Materials and Methods

This study seeks to contribute to the educational literature by examining and comparing the academic performance of students attending STEM model schools with those attending standard curriculum-based schools. Williams (2011) defines STEM education as a practice focusing on students being active participants in engineering and technology classes, leading to improved student outcomes in science and mathematics. Lantz (2009) describes that STEM education should remove learning and participation barriers and the siloed approach present in many disciplines allowing students to understand the world as a whole and not individual parts.

Current literature is mixed when showing the effectiveness of STEM focused curriculum. Some research has shown that STEM schools show statistically significant increases in math and science achievement, but this increase does not last over time (Öner & Capraro, 2016, Bicer et al., 2017), nor does it extend to all subjects under the educational umbrella. Betts and Tang (2014) used meta-analytic methods to show that STEM-based charter schools in New York City and Boston achieved gains compared to schools in non-metropolitan areas, although the effects in middle school reading and high school math were not statistically significant. Similarly, Zimmer et al. (2009) found no difference in student performance between STEM charter schools and public schools. With a focus on model performance as scored by the state of Texas in standardized testing and distinction awards, this investigation aims to shed light on the effectiveness of STEM-focused educational interventions in preparing students for the challenges and opportunities of the 21st-century workforce. Specifically, the study will involve students enrolled in T-STEM schools, P-TECH schools, New Tech Network schools, and Early College High Schools, geographically enclosed in Texas. These research questions will be answered.

1. Do distinct types of STEM school models such as T-STEM blueprint schools, New Tech Network Schools, P-TECH, and Early College High Schools outperform standard curriculum-based schools in terms of overall campus rating when controlling for numbers of students, percent economically disadvantaged and number or English Language learners?
2. Do distinct types of STEM school models such as T-STEM blueprint schools, New Tech Network Schools, P-TECH, and Early College High Schools receive more distinctions than standard curriculum-based schools after controlling for numbers of students, percent economically disadvantaged and number or English Language learners?
3. Do distinct types of variables such as school type, number of students, percentage of economically disadvantaged or percentage of emergent bilinguals determine if a school has a higher probability of receiving a distinction given by the state in Academic Achievement in English Language Arts/Reading, Academic Achievement in Mathematics, Academic Achievement in Science, Academic Achievement in Social Studies, Top 25 Percent: Comparative Academic Growth, Top 25 Percent: Comparative Closing the Gaps, or Postsecondary Readiness?

Research Design

This dissertation employs a correlation design to determine if there is an association between school models, particularly STEM (Science, Technology, Engineering, and Mathematics) and standard curriculum schools, when looking at academic performance. I decided to focus on correlational analysis to compare the school groups data against each other, make predictions about the school models and their data, as well as provide insights as to the strength of the relationship between groups. There are a few assumptions and limitations that must be considered with correlational studies. Causation among variables cannot be determined through a correlational study; as it does not allow us to determine a cause-and-effect relationship (Jackson, 2015). Additionally, confounding variables that are not being tested in the design could change outcomes (Creswell & Creswell, 2018). This limitation could be a large factor in this body of research, as there are many demographic variables that could also be considered that were not included. Specifically, this research study datasets were not collected directly by the researcher, and the survey or collection instruments were not validated as part of our design. Data collection issues could have occurred and were not disclosed in the used dataset (Babbie, 2016).

Data Sources

As of the 2022-2023 school year, 47,000 students were served by T-STEM campuses separated into ninety-five state-designated T-STEM Academies. 6,500 students are served by P-TECH schools with sixty-two designated P-TECH Schools and nineteen planning campuses for the 2019-2020 academic year. New Tech Network schools are comprised of thirty-four schools in thirteen school districts, with a student enrollment of over 15,000 students. Early College High Schools in Texas serve 65,000 students on 182 campuses (TEA, 2024).

Datapoints in this study consist of aggregate student data as reported by Texas from STEM schools and standard curriculum schools. A state overall accountability data set containing 10,173 schools retrieved from the Texas Education Agency Accountability Ratings Website located at https://tea.texas.gov/texas-schools/accountability/academic-accountability/performance-reporting was the starting point for research. This document contained all reported campuses in the state of Texas, their academic STAAR scores, the number of students, the percentage economically disadvantaged students, the percent of students that are classified as emergent bilinguals or English language learners, as well as scores comprising aggregate student achievement rating. Distinction awards were also contained in this document.

Entries that did not meet the inclusion criteria for the study and had missing data points for the variables of interest were removed from the dataset. Our dataset started with 10173 entries before any processing. I then removed campuses that were listed as alternative in nature (*n* = 404) leaving us with 9769 entries. Another reduction focused on removing campuses with missing campus numbers and grades served (*n* = 1178) reducing the dataset to 8591 entries. I further reduced the data set by removing campuses that did not receive overall ratings for the reporting year (*n* = 386) reducing the dataset to 8205 entries. A final reduction of the data was achieved by focusing on only high schools. This change was chosen to better represent the schools of interest, as many of the STEM models focus on upper-grade students.

Following these removals, the dataset contained (*n* = 1253) entries. Of the 1253 entries, 246 schools use the school models of interest. Specifically, the dataset contained 149 Early College High Schools, 36 T-STEM model schools, 49 P-Tech model schools, and 10 New Tech Network Schools. The remaining schools in the dataset (*n* = 1009) were classified as standard curriculum schools. A random number generator was used to narrow the selection to a representative sample of one hundred schools using a standard school model to prevent potential issues including school type group imbalance. This technique allows us to reduce issues developing from violating heterogeneity of variance. When controlling the number of entries exposed to the chosen statistical process, the power of that test is preserved and bias in the data is minimized (Mertler et al., 2021).

Ethical approval was sought from the institutional review board, and it was determined that this research does not meet the criteria for human subject research as described by the University of Texas at Tyler. Data Table 1 includes additional school descriptive statistics.

Table 1

Demographic Information of Target and Comparison Schools

	Student Maximum	Student Minimum	Average Number of Students	Average Economic Disadvantage	Average EB/ELL	Average Distinctions
ECHS	3870	48	1029	74%	18%	2.18
P-TECH	3966	195	1307	76%	27%	1.61
T-STEM	3107	81	1382	70%	21%	3.02
NTN	2089	127	738	38%	13%	3.4
Comparison Schools	3730	114	1122	53%	11%	2.08

Note: Early College High School (ECHS), Pathways in Technology (P-TECH), Texas Science, Technology, Engineering, Mathematics, New Technology Network (NTN)

Data on model performance scores were collected from Texas Education Agency school records for both STEM schools and standard curriculum schools. Model performance scores are standardized assessments designed to evaluate students' understanding and application of STEM concepts as well as campus progress, campus performance across racial and ethnic groups and how ready students are for entry into the workforce, college, or miliary. The scores are obtained from end-of-year assessments administered by the state of Texas as comprehensive standardized tests.at the respective schools. The State of Texas Assessments of Academic Readiness (STAAR) is the primary assessment used to measure student performance in core subjects. Tests are administered annually to students in grades 3-12.

Academic Grade Rating

The State of Texas uses an A-F accountability system created by the Texas Education Agency to evaluate how schools or districts are performing academically. The goal is to measure if a student is learning the appropriate skills for each grade, as well as the preparation of students for college, career, or the military. The Texas Education Agency looks at three individual domains to determine a school or district’s letter grade of A-F (TEA, 2019). The student achievement metric looks at student performance across all subjects, military readiness, college and career preparation, and graduation rates. The school progress metric is measured by outcomes in two areas; students that grew academically as measured by STAAR, and achievement of all students in the campus relative to or like a measured economically disadvantaged percentage. Finally, campuses are also graded on the closing the gaps metric, consisting of disaggregated student data that is used to demonstrate differences among racial and ethnic groups and their socioeconomic backgrounds (TEA, 2023).

A campus is given a student achievement score, based on a scale of 0-100 points. Letter grades are assigned based on 10-point intervals; for example, a score of 94 corresponds to an "A" rating, while a score of 82 corresponds to a "B" rating. Additionally, there is a school progress component, also rated on a 0-100 scale, with letter grades assigned using the same metric as student achievement scores. Lastly, schools are rated on their closing the gaps score, which measures how well a campus has addressed needs within student performance or other indicators. The closing the gaps measures use disaggregated data to describe racial/ethnic groups differences, socioeconomic status or background, percentage of special education services offered, mobility of students and emergent bilingual student percentages. These factors align the state accountability system with the Every Student Succeeds Act (TEA, 2019). This score is also based on a 0-100 scale.

The campus total score is based on a weighted STAAR component score of 40 percent, A college, military, and career readiness component score of 40 percent, and a graduation rate conversion of 20 percent. According to TEA “For campuses lacking a graduation rate component, weight the STAAR component scaled score at 50 percent and the CCMR component scaled score at 50 percent to determine the Student Achievement domain scaled score. For campuses lacking both the CCMR and the graduation rate components, the STAAR component scaled score is the Student Achievement domain scaled score. For campuses lacking the CCMR component, weight the STAAR component scaled score at 100 percent” (TEA 2023a).

To calculate the overall score of a campus, the higher score between student achievement and school progress is weighted at 70% of the final rating, while closing the gaps is weighted at 30%, making up a full 100%. The score is then rounded to determine the overall rating of a campus or district. This information is available on the Texas Education Agency's websites or in the Texas Academic Performance Reports (TAPR), which are released to districts (TEA, 2023a).

Distinctions

A distinction designation signifies that a campus has shown higher performance relative to a comparison group of campuses and must be placed in the top 25% of their comparison group. These campuses are comparable demographically and can be categorized based on size, type of school, number of grades, and student socio-economic makeup. Campuses and districts awarded accountability ratings of A, B, C, or D are eligible to earn distinctions. Distinctions can be awarded in the following areas for a campus or a district. Achievement in English Language Arts/Reading, mathematics**,** science, social studies, top 25 percent: comparative academic growth, top 25 percent: comparative closing the gaps, and postsecondary readiness for district and campus (TEA, 2023a).

Criteria for Economically Disadvantaged Campuses

The percentage of Economically Disadvantaged students at a school campus is primarily determined based on eligibility for free or reduced-price lunch under the National School Lunch Program (NSLP). School campuses collect this data during enrollment and verify it through documentation. This information, along with other indicators such as participation in public assistance programs, is reported to the Texas Education Agency (TEA) via the Public Education Information Management System (PEIMS). The TEA calculates the percentage by dividing the number of economically disadvantaged students by the total student enrollment. Schools with higher percentages of economically disadvantaged students receive additional resources to support low-income students (TEA 2023). These resources can include additional Title I funds, to provide additional academic support, staff salaries, and summer school programs. The resources can also include free and reduced lunch programs for students, and parent involvement activities families as well as the students.

Criteria for Determining Percentage of EB/ELL

The percentage of Emergent Bilinguals (EBs) or English Language Learners (ELLs) on a school campus is determined through a structured process starting with a Home Language Survey (HLS) completed by parents or guardians upon student enrollment. If the survey indicates a language other than English is spoken at home, the student is assessed using the Texas English Language Proficiency Assessment System (TELPAS) or a similar test to measure proficiency. Students not yet proficient in English are classified as EBs/ELLs. Schools report the number of EBs/ELLs to the Texas Education Agency through the Public Education Information Management System (PEIMS), with data updated every year. The TEA calculates the percentage of EBs/ELLs by dividing the number of identified EBs/ELLs by the total student enrollment at the campus (TEA, 2023a).

Chapter 4: Results

Variable Overview

Variables used in the analyses consist of School Type, representing STEM school models Early College High School (ECHS), Pathways in Technology (P-TECH), Texas Science Technology, Engineering, Mathematics (TSTEM), New Tech Network (NTN) and normal school models. Additionally, number of students on a campus, percentage of economically disadvantaged, emergent bilingual/English learners, and overall scores for a campus and total number of distinctions were dependent variables in the statistical analyses reported below. Additional variables include distinctions in reading, mathematics, science, social studies, campus progress, closing the gaps progress, and postsecondary readiness progress.

Statistical Analysis Choices

For research question 1 and 2, Analysis of Covariance (ANCOVA) was chosen as there are many covariates that could modify the dependent variable of interest. ANCOVA is a statistical model that blends ANOVA and regression and allows us to evaluate if the means of a dependent variable are equal across levels of one or more categorical independent variables while controlling for potential covariates. Several statistical assumptions need to be assessed before conducting ANOCVA. Specifically, data should be screened to ensure linear relationships between the dependent variables and covariates, linear relationships between pairs of covariates, uncorrelated error and independence of error terms, normality of data variables and homogeneity of error variances (Tabachnick & Fidell, 2007).

Although ANOCOVA is a powerful means comparison technique that allows researchers to control potentially confounding variables, the technique has limitations that should be considered. For instance, this statistical technique (and many methods) has reduced statistical power in small sample-size situations. Additionally, ANCOVA is susceptible to non-linear relationships in the collected data. Our grouping of variables in the dataset was chosen to maximize the schools of interest to preserve statistical power.

Research question 3 will utilize multiple logistic regression studies to determine campus differences regarding distinction awards. Mertler et al. (2021) state that a key strength of correlated multiple logistic regression analysis is that it allows researchers to identify patterns among study variables. A major limitation of this design is that correlation does not imply causation, an issue which many fall victim to in drawing conclusions.

Correlational Analysis

A series of Pearson correlation analyses were performed to evaluate the relationship between number of students, economically disadvantaged, emergent bilingual/English learning students, overall campus score, and number of distinctions. This statistical technique has several underlying assumptions that need to be met to obtain accurate results. I first verified that the observations among data sets were independent, and that the data was at the interval or ratio level. I then visually observed the residual plots to see if there was any indication of violation of homoscedasticity. The scatter plots seem to be randomly distributed and the analysis continued. I then moved to testing using Pearson correlation to verify bivariate normality. The analysis requires that both variables under consideration follow a joint normal distribution. This assumes that not only each variable is normally distributed, but the combination distribution of both should form an elliptical pattern when viewing the Q-Q plot. To check the assumptions of bivariate normality on all variables I utilized Shapiro-Wilk testing via the analytical package JASP. All pairs of variables returned statistically significant indicating issues with normality among the datasets. This information is presented in table 2.

Table 2

Shapiro-Wilk Test for Bivariate Normality

			Shapiro-Wilk	p
Number of Students	-	Economically Disadvantaged	0.950	< .001
Number of Students	-	EBEL Students	0.901	< .001
Number of Students	-	OverallScore	0.960	< .001
Number of Students	-	DISTINCTION_TOTAL	0.930	< .001
Economically Disadvantaged	-	EBEL Students	0.925	< .001
Economically Disadvantaged	-	OverallScore	0.981	< .001
Economically Disadvantaged	-	DISTINCTION_TOTAL	0.943	< .001
EBEL Students	-	OverallScore	0.900	< .001
EBEL Students	-	DISTINCTION_TOTAL	0.910	< .001
OverallScore	-	DISTINCTION_TOTAL	0.978	< .001

I then switched to Spearman's rho as a non-parametric option to test for correlation among groups. Number of Students had a moderate positive correlation ($r = .42$, $p < .001$) with EBEL students and a moderate negative correlation ($r = -.46$, $p < .001$) with Overall Score. Economically Disadvantaged had a strong positive correlation with EBEL students ($r = .67$, $p < .001$) and a moderate negative correlation with Overall Score ($r = -.34$, $p < .001$). EBEL students had a moderate negative correlation with Overall Score ($r = -.38$, $p < .001$). Overall score had a moderate positive correlation with Distinction Total ($r = .57$, $p < .001$). No other correlations were statistically significant. Table 3 contains all Spearman Correlations.

Table 3

Spearman's Correlations

			Spearman's rho	p
Number of Students	-	Economically Disadvantaged	0.167	0.002
Number of Students	-	EBEL Students	0.425	< .001
Number of Students	-	Overall Score	-0.461	< .001
Number of Students	-	DISTINCTION TOTAL	-0.097	0.071
Economically Disadvantaged	-	EBEL Students	0.670	< .001
Economically Disadvantaged	-	Overall Score	-0.345	< .001
Economically Disadvantaged	-	DISTINCTION TOTAL	-0.139	0.010
EBEL Students	-	Overall Score	-0.382	< .001
EBEL Students	-	DISTINCTION TOTAL	-0.064	0.238
OverallScore	-	DISTINCTION TOTAL	0.573	< .001

Data Analysis

For Research Question 1 and Research Question 2, data were analyzed using ANCOVA to compare the model performance of students in STEM schools versus standard curriculum schools.

Assumptions of ANCOVA analysis Research Question 1

I started testing the assumptions for ANCOVA concerning Overall Score by assessing normally distributed residuals. Residuals were observed using a Q-Q plot and were found to be left skewed but approximately normal in distribution. I then observed the normality of each school type versus overall score by observing the created Q-Q plot, with each being approximately normal upon visual inspection. I then conducted Levene's test for equality of variances. The results were statistically significant indicating that the homogeneity of variance assumption was violated, (F = 4.12, df = 4, 340, p = 0.003). To overcome these issues due to homogeneity of variance, I selected similar size group comparisons, a method that can be used to minimize issues (Rusticus & Lovato, 2019). Finally, I assessed interaction terms between the independent variable Overall Score and the covariates number of students, economically disadvantaged, emergent bilingual/ English learners, which were not significant, indicating homogeneity of regression slopes.

Quantitative Analysis Research Question 1

An ANCOVA concerning school type affecting overall score was conducted while controlling for number of students, percentage of economically disadvantaged, and percentage of EB/ELL students. School type was found to have a statistically significant impact on overall score (F (4,337) = 12.39, p <.001, ω^2 = .08). Number of students was also found to have a statistically significant impact on overall score (F (1,337) = 45.89, p < .001, ω^2 = .08). Additionally, percentage of economic disadvantaged students were shown to have a statistically significant impact on overall score (F (1,337) = 43.81, p < .001, ω^2 = .08). Emergent Bilingual/English Learners were not found to be statistically significant (F (1,337) = .002, p = .96, ω^2 = 0.0).

Post hoc testing utilizing Tukey's correction showed that Early College High Schools ($M_{marginal}$= 87.19, SD = 9.31) have overall scores higher than P-TECH schools (M_{marginal} = 79.59, SD = 8.11). There was a significant score benefit with Early College High Schools over traditional school models ($M_{marginal}$ = 84.45, *SD* = 7.10). All other comparisons were not considered significant. Table 4 contains marginal means for all school types. Table 5 contains post hoc comparisons.

Table 4

Marginal Means - School Type and Overall Score

		95% CI for Mean Difference		
School Type	**Marginal Mean**	**Lower**	**Upper**	**SE**
ECHS	87.990	86.833	89.147	0.588
PTECH	81.613	79.605	83.620	1.020
TSTEM	85.670	83.386	87.953	1.161
NTN	83.761	79.297	88.225	2.269
TM	82.364	80.916	83.812	0.736

Note: ECHS=Early College High School, PTECH = Pathways in Technology, TSTEM = Texas Science, Technology, Engineering, Mathematics, NTN = New Tech Network TM = Normal School Model

Table 5

Post Hoc Comparisons - School Type and Overall Score

		Mean Difference	SE	t	Cohen's d	p_{tukey}
ECHS	PTECH	6.377	1.168	5.458	0.921	< .001
	TSTEM	2.320	1.301	1.784	0.335	0.385
	NTN	4.229	2.378	1.779	0.611	0.388
	TM	5.626	0.977	5.758	0.813	< .001
PTECH	TSTEM	-4.057	1.530	-2.651	-0.586	0.064
	NTN	-2.148	2.510	-0.856	-0.310	0.913
	TM	-0.751	1.298	-0.579	-0.108	0.978
TSTEM	NTN	1.908	2.563	0.745	0.276	0.946
	TM	3.306	1.386	2.385	0.477	0.122
NTN	TM	1.397	2.335	0.598	0.202	0.975

Note. P-value adjusted for comparing a family of five. ECHS=Early College High School, PTECH = Pathways in Technology, TSTEM = Texas Science, Technology, Engineering, Mathematics, NTN = New Tech Network TM = Normal School Model

Assumptions of ANCOVA analysis Research Question 2

I started testing the assumptions for ANCOVA concerning Overall Score by assessing normally distributed residuals. Residuals were observed using a Q-Q plot and were found to be left skewed but approximately normal in distribution. Residuals were observed using a Q-Q plot and were found to be platykurtic in distribution, light tailed, but approximately normal. I then observed normality for each school type versus overall score by observing the Q-Q plot, with each being approximately normal upon visual inspection. I then conducted a Levene's test for equality of variances, (F = 1.69, df = 4,340, p = 0.15), confirming homogeneity of variance. I verified that variables were independent, then assessed the homogeneity of regression slopes by comparing the interaction terms between the independent variable number of distinctions and the covariates number of students, economically disadvantaged, emergent bilingual/ English learners, to make sure they were not significant.

Quantitative Analysis Research Question 2

An ANCOVA concerning school type affecting total number of distinctions was conducted while controlling for number of students, percentage of economic disadvantaged, and percentage of EB/ELL students. School type was found to have a significant impact on total number of distinctions (F (4,337) = 3.08, p = .01, ω^2 = .02). This impact only accounts for two percent of variation in school performance, however. The number of students covariate was not statistically significant (F = (1,337) = 2.04, p = .15, ω^2 = .00). Emergent bilingual/ English learners' covariate was not statistically significant (F = (1,337) = 0.42, p = .51, ω^2 = .00). The economically Disadvantaged covariate additionally was not significant, (F = (1, 337) = 3.44, p = .06, ω^2 = .00).

Post hoc testing utilizing Tukey's correction showed that P-TECH Schools (M_{marginal} = 1.61, *SD* = 1.84) have values less than T-STEM schools (M_{marginal} = 3.02, *SD* = 2.37) regarding number of distinctions. Testing also indicated that T-STEM schools have values less than New Tech Network school types (M_{marginal} = 3.40, *SD* = 1.89) when considering the number of distinctions. All other comparisons were not considered statistically significant. Table 6 contains marginal means for school types, and Table 7 contains post hoc comparisons.

Table 6

Marginal Means - School Type and Number of Distinctions

School Type	Marginal Mean	95% CI for Mean Difference		SE
		Lower	Upper	
ECHS	2.257	1.907	2.607	0.178
PTECH	1.709	1.101	2.318	0.309
TSTEM	3.100	2.408	3.792	0.352
NTN	2.994	1.642	4.346	0.687
TM	1.945	1.506	2.383	0.223

Note: ECHS=Early College High School, PTECH = Pathways in Technology, TSTEM = Texas Science, Technology, Engineering, Mathematics, NTN = New Tech Network TM = Normal School Model

Table 7

Post Hoc Comparisons - School Type and Distinction Total

		Mean Difference	SE	t	Cohen's d	p_{tukey}
ECHS	PTECH	0.548	0.354	1.547	0.261	0.533
	TSTEM	-0.843	0.394	-2.140	-0.402	0.206
	NTN	-0.737	0.720	-1.023	-0.351	0.845
	TM	0.312	0.296	1.056	0.149	0.829
PTECH	TSTEM	-1.391	0.464	-3.000	-0.663	0.024
	NTN	-1.284	0.760	-1.689	-0.612	0.442
	TM	-0.235	0.393	-0.598	-0.112	0.975
TSTEM	NTN	0.106	0.776	0.137	0.051	1.000
	TM	1.156	0.420	2.752	0.551	0.049
NTN	TM	1.049	0.707	1.483	0.500	0.574

Note. P-value adjusted for comparing a family of five. ECHS=Early College High School, P-TECH = Pathways in Technology, TSTEM = Texas Science Technology, Engineering, Mathematics, NTN = New Tech Network, TM = Normal School Model

Assumptions of Logistic Regressions Research Question 3

Multiple logistic regressions were conducted to investigate which, if any, demographic variables (number of students, economic disadvantaged, emergent bilingual/ English language learner) and school model types (early college high school ECHS, pathways in technology P-TECH, Texas Science, Technology, Engineering, Mathematics T-STEM, New Technology Network NTN, standard model) generated a significant measurable change in the likelihood of receiving an academic achievement from the Texas Education Agency. Specifically, I will focus on the specific distinctions; (1) English language arts/reading, (2) mathematics, (3) science, (4) social studies, (5) top 25 percent: comparative academic growth, (6) top 25 percent: comparative closing the gaps, (7) postsecondary readiness. When the model fit is generated, interpretation of the coefficients allows you to discover the contributions of each predictor while controlling for others. Assumptions of multiple logistic regression include linearity between continuous predictors and the logit of the dependent variable, and the absence of multicollinearity among the predictors of interest.

I started the analysis by checking the assumptions of logistic regression by conducting a Box-Tidwell Method (1962), which is utilized to check for linearity among the independent variables and the log odds. This method utilized introduced variables, in the case of this study natural logarithm of the covariates, and an interaction term of the natural logarithm multiplied by the covariate to determine linearity. The factor interaction was non-significant in all seven cases, allowing us to maintain the assumption of linearity and adding validation to the multiple logistic regression models. Multicollinearity for all logistic regressions was then checked within JASP with Tolerance and VIF values falling within acceptable values for assumptions of non-multicollinearity. Generally, VIF values between 5 and 10 show that data is non-multicollinear. Tolerance values of between .1 and .25 also suggest that data is non-multicollinear (Goss-Sampson, 2019; James et al., 2013). During the logistic regression analysis, multiple groups were dummy coded to measure the influence of a single school model. Specifically, STEM models were coded as the predictor of interest, and our reference group, standard curriculum schools remained the same for all logistic regressions. Table 8 contains the ranges of Tolerance and VIF values for all logistic regressions.

Table 8

Multicollinearity Diagnostic ranges for all regressions

	Tolerances	VIF
Number of Students	0.83-0.85	1.16-1.19
Economically Disadvantaged	0.47-0.52	1.91-2.09
EBEL Students	0.47-0.53	1.91-2.09
PTECH	0.67-0.75	1.31-1.48
TSTEM	0.72-0.78	1.28-1.38
NTN	0.88-0.91	1.09-1.13
ECHS	0.59-0.63	1.56-1.79

Note: Pathways in Technology (PTECH), Texas Science, Technology, Engineering, Mathematics (TSTEM), New Technology Network (NTN), Early College High School (ECHS)

Distinction English Language Arts Reading

The tested model was statistically significant, (X^2 =20.79, df = 337, p = 0.00, McFadden R^2 = 0.04). The independent variables have low predictive power and are weakly related to receiving a distinction in ELAR according to McFadden (1973) interpretation methods. Post hoc testing using the Wald test showed that T-STEM schools are related to the outcome (W (1) = 10.42, p < .001). Specifically, a T-STEM school has a 292% better chance of getting an English language arts distinction versus the standard school model. New Tech Network schools have a 328% chance of receiving an English language arts distinction than traditional school models (W (1) = 4.28, p < .05), when controlling for student numbers, economically disadvantaged or emergent bilingual students. Table 9 contains Wald Test statistics for all variable relationships.

Table 9

Significant independent variable relationships distinction ELAR

				Wald Test			
	Estimate	**Standard Error**	**Odds Ratio**	**z**	**Wald Statistic**	**df**	**p**
(Intercept)	-0.148	0.406	0.863	-0.36	0.132	1	0.716
Number of Students	-0.000	0.000	1.000	-0.52	0.273	1	0.601
Economically Disadvantaged	-0.451	0.703	0.637	-0.64	0.412	1	0.521
EBEL Students	-1.589	1.085	0.204	-1.46	2.142	1	0.143
PTECH (1)	0.456	0.396	1.578	1.152	1.327	1	0.249
TSTEM (1)	1.367	0.423	3.925	3.229	10.428	1	0.001*
NTN (1)	1.454	0.741	4.280	1.963	3.855	1	0.050*
ECHS (1)	0.178	0.300	1.195	0.595	0.354	1	0.552

Note. Significant values designated with a *.

Distinction Mathematics

The tested model for receiving a mathematics distinction was not statistically significant, (X^2 =13.90, df = 337, p = 0.53, McFadden R^2 = 0.03). T-STEM campuses, however, return a statistically significant value during Post hoc testing (*W* (1) = 7.62, *p* = .006, OR = *3.19).* This effect should be looked at with suspicion, based on the overall model fit values. Table 10 contains coefficient values for the test.

Table 10

Significant independent variable relationships distinction mathematics

	Estimate	Standard Error	Odds Ratio	z	Wald Test: Wald Statistic	Wald Test: df	Wald Test: p
(Intercept)	-0.727	0.430	0.483	-1.69	2.858	1	0.091
EBEL Students	0.283	1.117	1.327	0.253	0.064	1	0.800
Economically Disadvantaged	-0.803	0.747	0.448	-1.07	1.155	1	0.283
Number of Students	0.000	0.000	1.000	0.341	0.116	1	0.733
PTECH (1)	-0.303	0.460	0.738	-0.65	0.434	1	0.510
ECHS (1)	0.406	0.317	1.501	1.279	1.635	1	0.201
TSTEM (1)	1.161	0.421	3.194	2.761	7.623	1	0.006*
NTN (1)	0.966	0.688	2.626	1.404	1.971	1	0.160

Note. Significant values designated with a *.

Distinction Science

The tested model was statistically significant, (X^2 = 21.77, df = 337, p = 0.003, McFadden R^2 = 0.05). The independent variables have low predictive power and are weakly related to receiving a distinction in science according to McFadden interpretation (1973). Post hoc testing utilizing the Wald Test shows that Early College High Schools statistically significantly influences the likelihood of receiving a distinction in science, (W (1) = 4.53, p = .03, OR = .51). Early College High Schools likelihood of receiving a science distinction is 49% less than the traditional school model. No other variables returned significant effects. Table 11 contains variable relationship values for the test.

Table 11

Significant independent variable relationships distinction science

					Wald Test		
	Estimate	**Standard Error**	**Odds Ratio**	**z**	**Wald Statistic**	**df**	**p**
(Intercept)	-0.064	0.422	0.938	-0.15	0.023	1	0.879
Number of Students	0.000	0.000	1.000	0.102	0.010	1	0.919
Economically Disadvantaged	-1.231	0.750	0.292	-1.64	2.689	1	0.101
EBEL Students	2.058	1.107	7.829	1.858	3.454	1	0.063
ECHS (1)	-0.660	0.310	0.517	-2.12	4.533	1	0.033*
PTECH (1)	-0.731	0.425	0.481	-1.72	2.963	1	0.085
TSTEM (1)	0.580	0.409	1.786	1.419	2.013	1	0.156
NTN (1)	0.264	0.680	1.302	0.387	0.150	1	0.698

Note. Significant effects designated with *.

Distinction Social Studies

The tested model for receiving a social studies distinction was not statistically significant, (X^2 =7.61, df = 337, p = .36, McFadden R^2 = 0.01). The tested school model factors (Early college high school, P-Tech, T-STEM, New Tech Network, normal school model) and covariates (number of students, economically disadvantaged, emergent bilingual/English Learners) did not influence the likelihood of receiving a distinction in social studies. Table 12 contains coefficient values for the test.

Table 12

Significant independent variable relationships distinction social studies

					Wald Test		
	Estimate	**Standard Error**	**Odds Ratio**	**z**	**Wald Statistic**	**df**	**p**
(Intercept)	-0.48	0.42	0.61	-1.15	1.33	1	0.24
Number of Students	0.00	0.00	1.00	0.39	0.15	1	0.69
Economically Disadvantaged	-1.17	0.73	0.31	-1.59	2.54	1	0.11
EBEL Students	1.12	1.08	3.07	1.04	1.08	1	0.29
ECHS (1)	0.30	0.31	1.35	0.97	0.94	1	0.33
PTECH (1)	-0.14	0.42	0.86	-0.33	0.11	1	0.74
TSTEM (1)	0.65	0.42	1.91	1.54	2.39	1	0.12
NTN (1)	0.75	0.68	2.12	1.10	1.20	1	0.27

Note. Distinction Social Studies level '1' coded as class 1.

Distinction Progress

The tested model for receiving a distinction in school progress was not statistically significant (X^2 = 2.65, df = 337, $p = .91$). The tested school model factors (Early college high school, P-Tech, T-STEM, New Tech Network, normal school model) and covariates (number of students, economically disadvantaged, emergent bilingual/English Learners) did not influence the likelihood of receiving a distinction in school progress as measured by the state of Texas. Table 13 contains Wald Test statistics for all variable relationships.

Table 13

Significant independent variable relationships distinction progress

					Wald Test		
	Estimate	**Standard Error**	**Odds Ratio**	**z**	**Wald Statistic**	**df**	**p**
(Intercept)	-1.07	0.46	0.34	-2.32	5.42	1	0.02
Number of Students	-0.00	0.00	1.00	-0.26	0.07	1	0.78
Economically Disadvantaged	-0.16	0.80	0.85	-0.20	0.04	1	0.83
EBEL Students	0.39	1.17	1.48	0.33	0.11	1	0.73
ECHS (1)	-0.01	0.33	0.98	-0.04	0.00	1	0.96
PTECH (1)	-0.48	0.48	0.61	-1.00	1.01	1	0.31
TSTEM (1)	0.34	0.44	1.41	0.76	0.59	1	0.44
NTN (1)	-0.26	0.83	0.76	-0.31	0.10	1	0.75

Note. Distinction Progress level '1' coded as class 1.

Distinction Closing the Gaps

The tested model was statistically significant (X^2 =32.13, df = 337, p < 0.001, McFadden R^2 = 0.07). The Independent variables have low predictive power and are weakly related to receiving a distinction in science according to McFadden interpretation (1973). The number of Students variable was found to be statistically significant (W (1) = 14.75, p <.001, OR = .99), indicating a minuscule negative association. Specifically, the number of students on a campus lowers the likelihood of receiving a closing the gaps distinction by 1 percent. No other variable relationships were significant. Table 14 contains Wald Test statistics for all variable relationships.

Table 14

Significant independent variable relationships closing the gaps

					Wald Test		
	Estimate	**Standard Error**	**Odds Ratio**	**z**	**Wald Statistic**	**df**	**p**
(Intercept)	-0.29	0.43	0.74	-0.66	0.43	1	0.50
Number of Students	-0.00	0.00	0.99	-3.84	14.75	1	< .001*
Economically Disadvantaged	-0.36	0.77	0.69	-0.40	0.21	1	0.64
EBEL Students	0.42	1.19	1.53	0.35	0.12	1	0.72
ECHS (1)	0.51	0.32	1.66	1.57	2.46	1	0.11
PTECH (1)	-0.70	0.52	0.49	-1.34	1.79	1	0.18
TSTEM (1)	0.08	0.48	1.08	0.17	0.02	1	0.86
NTN (1)	0.46	0.70	1.59	0.66	0.43	1	0.50

Note. Significant effects designated with a *.

Distinction Post Secondary Readiness

The tested model was statistically significant, (X^2 =22.81, df = 337, p < 0.002, McFadden R^2 = 0.05). The Independent variables have low predictive power and are weakly related to receiving a distinction in science according to McFadden interpretation (1973). Number of Students variable was found to be significant, (*W* (1) = 6.48, *p* = .01, OR = 1.0). This significant effect should be viewed with caution, as Odds ratios reported at 1.0 mean there is no association between variables of interest. The significance of this effect could be attributed to an extremely low standard error value in this test. Economically disadvantaged was found to be significant, (*W* (1) = 6.83, *p* = .009, OR = .15) indicating a negative association and an 85% lower chance of receiving a distinction in post-secondary readiness with each 1 unit increase in the Economically disadvantaged variable. Early College High School was also found significant, (*W* (1) = 5.57, *p* = .01, OR = 2.07), indicating a strong positive association and a 107% better chance of receiving a distinction in post-secondary readiness versus the standard school model. T-STEM was also found to be significant, (*W* (1) = 4.73, *p* = .03, OR = 2.5, indicating a strong positive association, and a 152% better chance of receiving a distinction in post-secondary readiness versus a standard school model. Table 15 contains coefficient values for the test.

Table 15

Significant independent variable relationships distinction Postsecondary Readiness.

					Wald Test		
	Estimate	**Standard Error**	**Odds Ratio**	**z**	**Wald Statistic**	**df**	**p**
(Intercept)	0.50	0.41	1.66	1.24	1.54	1	0.21
Number of Students	-0.00	0.00	1.00	-2.54	6.48	1	0.01*
Economically Disadvantaged	-1.88	0.72	0.15	-2.61	6.83	1	0.009*
EBEL Students	0.80	1.06	2.23	0.75	0.57	1	0.44
ECHS (1)	0.73	0.31	2.07	2.36	5.57	1	0.01*
PTECH (1)	0.25	0.41	1.28	0.60	0.36	1	0.54
TSTEM (1)	0.92	0.42	2.52	2.17	4.73	1	0.03*
NTN (1)	0.81	0.71	2.26	1.15	1.32	1	0.25

Note. Significance indicated with *.

Chapter 5: Conclusions

This dissertation's main aim was to investigate the effectiveness of various STEM school models versus the standard state of Texas curriculum model for high school campuses. Following a thorough examination of the literature and empirical research using ANCOVA, Logistic Regression and other statistical methods, the following conclusions have been drawn.

Summary of Findings

Regarding Research Question 1:

Research question one focused on describing if distinct types of STEM school models such as T-STEM blueprint schools, New Tech Network Schools, P-TECH, Early College High Schools outperform standard curriculum-based schools in terms of overall campus rating when controlling for numbers of students, percent economically disadvantaged and number or English Language learners? The findings from an ANCOVA indicate that school type does influence the overall score a campus achieves in their given rating by the state of Texas. Early College High Schools (ECHS) significantly outperformed P-TECH schools and traditional school models, but only slightly. This suggests that the approaches employed by Early College High Schools, such as dual credit and enrollment opportunities and a college readiness centered curriculum may better support student achievement, but more research needs to be done to find if the model can be improved. These findings align with the findings of Young et al., (2016), Means et al., (2016) showing students from STEM school-based models, showed improvement in mathematics, and reading and were also less likely to have absenteeism, but struggled to show gains in other subjects and across grade levels. Students in Young’s study were also 1.5 times more likely to meet proficiency standards in reading, history, science, and mathematics, but struggled to maintain the knowledge in later grade levels. The data also suggests that the number of students enrolled on a campus and the percentage of economically disadvantaged students alone can have an influence on the overall score a campus receives from the state of Texas models.

The analysis also highlighted that a higher student population on a campus can be associated with lower overall scores, indicating that larger school sizes may negatively impact student performance. This underscores potential benefits of smaller school environments, allowing students to receive personalized attention and more directed resources like curriculum (Leithwood & Jantzi, 2009; Schwartz et al., 2013). Additionally, schools with a higher percentage of economically disadvantaged students have lower overall scores emphasizing the ongoing challenges and the need for targeted interventions that these students may need to be successful (Egalite & Kisida, 2018; Gershenson et al., 2016). An interesting data point from analysis one is that the percentage of EB/ELL students did not significantly affect overall score as calculated by the state of Texas. This finding contradicts current literature from (Bach, 2020, García et al., 2008) that states that EB and ELL students struggle with language barriers when taking state mandated testing. This suggests that other factors may be in play for these students in determining their effect on overall education attainment on the campus. These pieces of literature and others could have influenced the TEA to create a support division to access and assist campuses and districts with emergent bilingual and English language learner related questions (TEA, 2024) spending valuable resources that may have been better focused elsewhere.

Regarding Research Question 2:

Research question two focused on determining if STEM based school models such as T-STEM blueprint schools, New Tech Network schools, P-TECH schools, and Early College High Schools receive more distinctions than standard curriculum-based schools after controlling for numbers of students, percent economically disadvantaged and number or English Language learners.The ANCOVA analysis demonstrated that school type can also significantly influence the total number of distinctions awarded to a campus, after controlling for number of students, percentage of economically disadvantaged, and percentage of emergent bilingual/English learners. New Technology Network schools had higher distinction totals compared to T-STEM schools, and T-STEM schools received significantly more distinctions than P-TECH schools. The specialized focus of T-STEM and New Tech Network schools on science, technology, engineering, and mathematics (STEM) education, as well as project-based learning, may contribute to their higher achievement in earning distinctions. This again aligns with Berends and Donaldson (2016) and their single subject improvement findings showing that STEM focused models can improve student's outcome in a single subject, specifically mathematics and reading, but can have little to no effect in other subject areas.

Despite the significant influence of school type, the number of students, the percentage of economically disadvantaged students, and the percentage of EB/ELL students were not significant predictors for the number of distinctions a campus may receive. This suggests that distinctions may be awarded based on factors more directly related to school practices and educational models rather than demographic characteristics. The finding shows that performance among school types is similar, even with differences in demographics, and that varied curricular approaches and instructional methods are important in achieving academic recognition in the state of Texas.

Regarding Research Question 3:

Multiple binary logistic regressions were conducted for Research Question 3 to identify if variables such as school type, number of students, percentage economically disadvantaged or percentage of emergent bilinguals determine if a school has a higher probability of receiving a distinction given by the state of Texas in Academic Achievement for English Language Arts/Reading, Mathematics, Science, Social Studies, top 25 percent: Comparative Academic Growth or comparative Closing the Gaps, and Postsecondary Readiness. The analysis revealed that T-STEM and New Tech Network schools were significantly more likely to receive distinctions in English Language Arts/Reading compared to P-TECH and Early College High Schools, when compared against standard school models, showcasing the effectiveness of their specialized curricula and instructional methods in promoting literacy and language skills. Research from Berends and Donaldson (2016) showed that STEM focused schools improve subject performance in individual subject areas, like math or reading. The findings from this study also aligns with research from Means et al., (2016) showing higher student achievement and literacy skills in STEM high schools, and specifically literature from Kallick et al., (2017) showing that New Tech Networks focus on student centered instruction has increased literacy outcomes. A point of interest comes from looking at the effects of Early College High Schools on Science distinctions. Indicators for distinction in science include scores for students as early as grade five and grade eight. This early snapshot of student performance can hinder later placement when the student moves into an Early College High School campus (TEA, 2022). Early College High Schools by design are created to bridge a gap for underserved students, whose background may not have the support structure to excel in subjects at the college level (Texas College and Career Ready Schools, 2024).

The model for predicting distinctions in closing the gaps was significant, although the predictive power was low. The number of students had a minuscule but significant negative association with the likelihood of receiving a distinction in this area, reinforcing the earlier finding that larger school sizes may pose challenges to student performance and recognition. Some campuses show improvement in certain subject areas, while other campuses do not. This suggests that schools aiming to close achievement gaps may benefit from understanding their student makeup and maintaining smaller, more manageable student populations to enhance individual support and achievement. A national empirical study conducted by Greene et al., (2006) found students in Texas and Florida charter schools, which typically have STEM based models and smaller class sizes, outperformed their public-school peers, reinforcing the findings from sections of this research study.

Null Effects

The analysis conducted revealed several null findings regarding the impact of several factors on academic performance and distinctions between STEM and traditional school models. Specifically, ANCOVA results indicated that being an Emergent Bilingual/English Learner (EB/ELL) did not significantly affect overall academic scores, which aligns with findings from Robinson-Cimpian and Thompson (2016), emphasizing the multiple influences on EB/ELL students' performance. The percentage of economically disadvantaged students within a school similarly was not a significant predictor of the number of distinctions earned, supported by Sirin's (2005) meta-analysis which found that socioeconomic status, while important, can be moderated by other factors like school resources and teacher quality.

Additionally, the number of students in a school did not significantly impact the total distinctions achieved, supported by the findings by Lee and Smith (1997) that school size alone does not directly correlate with academic outcomes. Furthermore, while T-STEM and P-TECH schools demonstrated specific distinctions in certain areas, they did not consistently outperform traditional schools across all metrics. This is consistent with Means et al. (2016), who reported that specialized STEM school models can show benefits in certain contexts but do not guarantee superior performance across all academic measures. These findings highlight the complexity of educational environments and multiple factors must be considered to understand and academic outcomes fully.

Implications for the field of Education

The implications of this research into these specialized models, T-STEM (Texas Science, Technology, Engineering, and Mathematics), P-TECH (Pathways in Technology), Early College High Schools (ECHS), and New Tech Network campuses are significant for the field of education. By examining the impacts that these specialized educational models have on student performance in academic subjects and academic outcomes as reported by the state of Texas, this study provides a more nuanced understanding of their effectiveness. The findings suggest that the performance of students in these schools is mixed when compared to their peers in standard curriculum schools, indicating that while some STEM models show promise, others may not consistently outperform traditional educational approaches in STEM subjects.

Beyond academic performance, this research addresses a critical gap in understanding the broader impacts of specialized STEM education on non-STEM subjects and overall student success. Preliminary findings indicate that while some T-STEM, P-TECH, ECHS, and NTN schools excel in fostering STEM proficiency, others may not demonstrate significant differences or may even lag in certain areas. This underscores a need for a more holistic approach in research to ensure that specialized models do not inadvertently neglect the comprehensive development of students. As educators and policymakers strive for balanced educational reforms, these insights could guide the integration of cross-disciplinary strategies that support well-rounded student growth. The study highlights the importance of adapting educational programs to meet the diverse needs of students and ensuring that no single approach is universally applied without regard for context.

Implications for Practice

The findings of this study have practical implications for not only education design, but campus makeup, placement, resource allocation, and education policy. Researchers should investigate the specific resources and support mechanisms that Early College High Schools utilize and discover why their science achievement scores are statistically lower than other school models. A particular focus of interest would be in districts that mainly serve economically disadvantaged or ELL populations. Policy recommendations would be two-fold and at two governmental levels. At the local level, examination of funding, teacher training, and community involvement in supporting economically disadvantaged students should take place to see what issues can be effectively tackled to close the gaps in school models. Ensuring that schools that have higher levels of economically disadvantaged students receive adequate and equitable funding can reduce achievement gaps (Baker et al., 2016; Lafortune et al., 2018).

A focus on effective teacher training and development can also help support learners from all backgrounds (Gay, 2018).and a drive to involve the community to engage with a campus helps build support systems for students outside the school walls (Epstein & Sheldon, 2022). Effective strategies in these areas could mitigate the negative impact of these factors on campus ratings. State and national level government bodies should advocate for policies that provide additional support and resources to schools with high percentages of economically disadvantaged students and ELLs. This could include increased funding, access to high-quality instructional materials, and professional development for teachers. These agencies should be encouraged to research and uncover the best practices from Early College High Schools and New

Tech Network school models, particularly focusing on college readiness programs, partnerships with higher education institutions, and comprehensive student support services, and how best to integrate them into other school models.

While understanding the practical implications of a STEM based school model is crucial for educators and policymakers, it is equally important to address the foundational elements that drive these practices. Central to the success of any STEM initiative is the ability to foster genuine interest and engagement in students. This necessitates a closer examination of the factors that influence students' enthusiasm for STEM fields, including the pervasive stereotypes and sexism that can hinder equitable participation. By exploring these underlying issues, we can better understand how to create an encouraging environment that supports all students in their STEM endeavors.

Interest Generating Practices and Instruction

Many students are presented with STEM subjects as exciting and innovative study areas, but are often left disconnected from other subject study, and lacking connections that the student can apply to the real world (Lederman & Abell, 2014). Rebecca Lai, chemistry professor at University of Nebraska-Lincoln, has received national recognition for her undergraduate chemistry course that integrates the Intellectual property of Harry Potter into abstract discussions about chemical composition (Burks et al., 2017). Additional literature shows that allowing students to build three dimensional objects allows for increased creativity and critical thinking skills that can then be applied elsewhere in their classroom journeys (Bicer et al., 2017). These extended informal educational opportunities allow educators to build interest in students' minds, without being stuck in a direct instruction model based on behaviorist teaching methods. Problem-based learning or instruction is a method of integrative teaching strategies that use directed problems and real-world issues, allowing a student to have control of the learning pathway used to solve the presented problem (Evensen & Hmelo, 2000; Kauchak & Eggen, 2012). Hmelo-Silver (2004) also suggests that problem-based design allows students to create flexible knowledge that can be applied to other situations. Problem-based systems also allow for adaptation to fit students' developmental levels and are easily scalable by trained practitioners (Hmelo-Silver, 2004). Benge and Harder (2008) state that building interest is one of the important tenets of allowing students to be engaged in learning. Interests, or generation of new interests, allow you to engage prior knowledge of students and assist them in making connections to current and future learning opportunities. Research has shown that students instructed using an integrated STEM curriculum perform equally or better than peers in traditional separate discipline study (Czerniak et al., 1999; Hinde, 2005). Real world problems are not siloed in individual class subjects or taught in a method that mirrors problems based on how the world currently operates so our curriculum should not be presented in this same manner (Beane, 1995; Czerniak et al., 1999).

Research spanning two decades has called for additional investment and importance given to STEM subjects, to prepare our workforces for jobs that do not currently exist, and to help everyone be ready for a STEM adjacent future (Widya et. al., 2019). The focus on successful STEM instructional practices and implementation into today's classrooms will help us avoid a technology knowledge deficit in the upcoming years. As stated earlier, society has recognized that everyone needs training in our technology driven future, STEM education presents the best pathway for us to educate all our population. Critical thinking, communication, self-directed learning, and more functional ideals come from a focus in the STEM fields, and we as educators must not shy away from taking any of these presented instructional practices and integrating them into all subject areas to prepare our students for the next generation of professionals in STEM fields. As stated earlier in this document, STEM-literacy, understanding the nature of Science, Technology, Engineering and Mathematics, should be a priority for every student, regardless of creed, gender, or race (National Academy of Engineering and National Research Council, 2011).

Stereotypes and Sexism in STEM

Research into stereotypes and stereotype threats has been conducted to see if preconceived ideas affect student performance in subjects (Bicer et al., 2015; Thomas, 2018). Females have been constantly underrepresented in STEM academic fields and in the STEM workforce (Hill et al., 2010; National Science Foundation, 2016). However, the underrepresentation cannot be attributed to gender performance in STEM fields (Halpern et al., 2007). Studies have shown that relative performance of males to females, females earn more credits in math and science and have higher combined scores regarding grade point averages (Hill et al., 2010). There is a need for us to make sure that during education, we do not inadvertently promote inequity and limit the potential of males or females in STEM focused classes. (Atthill & Jha, 2009). Respect and relationship building has been shown to foster developmental skills including social responsibility and communication (Leach, 2022) while equitable strategies must be integrated into the classroom daily (Kansman et al., 2022) for students to feel safe and develop a mindset for learning.

Implications of Null Findings:

The absence of statistically significant differences in overall scores between school models suggests that there may be other factors that could be influencing academic performance of these models. Confounding variables that were not considered but could cause differing results in these finding include subpopulation splits, which would allow us to look at academic performance by race, or gender percentages, allowing us to determine if there are any differing effects between males and females when considering school models. Sample size can also be a confounding variable that could be considered in additional studies. Statistically significant Null findings could be due to the small effect sizes of the predictors, lack of sensitivity in measurement, or other unmeasured variables (Tabachnick and Fidell (2007). Reinholz and Andrews (2020) conducted a systematic review of literature and found that various interventions and educational reforms in STEM often failed to produce the expected systemic changes researchers were looking for while Freeman et al., (2015) found that often STEM school model program success cannot be measured on a significant scale, underscoring the importance of evaluating the chosen model and the students it will benefit. The multifaceted nature of education and educational outcomes shows a need for continuous and comprehensive approaches in future research. It also shows that no school model is a catch all for academic achievement. Educational success is influenced by a multitude of factors, including socio-economic background, teacher effectiveness, resources available to schools, and student engagement in the classroom and on campus. It is essential that future research not only examines the effectiveness of different educational models but also considers the interplay of these factors. A developed comprehensive approach can provide nuanced insights into how various elements contribute to student achievement and can guide the development of more effective educational strategies and policies. Additionally, it highlights the importance of iterative research, where findings are continually updated and refined to reflect the evolving educational landscape.

Limitations

Several limitations should be acknowledged when interpreting the findings of this study. Firstly, the study design is correlational, which limits the ability to establish causality between school type and model performance. Secondly, the generalizability of the findings may be limited to the specific context of the study region. Additionally, this analysis only focuses on high school campuses, with students in grades 9-12, as identified by the state. The outcomes may be different if the comparisons were open to all grade levels, or in different states. The study was conducted on secondary data sources publicly available and unable to be manipulated or changed by the researcher, which could have unknown biases or measurement errors. This leaves unanswered questions on the validity of the dataset and how factors were deemed important or not important to the state of Texas. While validity and reliability statements exist for STAAR assessments, there was no way for me to validate that student types and student populations were correct for the sampled campuses. Other demographic information that could be used as covariates was not part of the dataset and if integrated into the analysis could lead to differing results. Additional information from Texas Academic Performance Reports (TAPR), or additional reports from the Texas Performance Reporting System (TPRS) (TEA, 2023) could be included to add robustness to the data.

This study did not include any qualitative methods to increase validity or expand the findings beyond just the quantitative numbers. Qualitative research can also be conducted to complement the quantitative findings from this dissertation to give a comprehensive understanding of the issues surrounding school achievement. Johnson and Onwuegbuzie (2004) showed that using a mixed methods approach allows for deeper and more nuanced insights on what was occurring than just quantitative data alone. Understanding the experiences of students, teachers, and administrators in different STEM school models allows their insights to provide valuable context to the quantitative data and highlight areas for improvement that numbers alone might not reveal.

Final Reflections

In conclusion, this dissertation has provided a comprehensive analysis of school models and their relative performance to each other based on data collected by the state of Texas regarding student performance. The research underscores the complexity of understanding educational outcomes and the factors, internal and external, that can influence campus ratings and distinctions. The analyses provide important insights into how different school types can influence student outcomes and the awarding of distinctions. Early College High Schools and New Tech Network schools generally perform better in overall scores and distinction awards compared to T-STEM schools, P-TECH schools, and normal school models. The number of students and the percentage of economically disadvantaged students are crucial factors that negatively impact overall scores, whereas the percentage of EB/ELL students did not show a significant effect. These findings suggest that targeted strategies to support economically disadvantaged students and manage school sizes could help improve student performance across different school models. The inclusion of STEM based practices, such as those in our school models of interest, have been shown to increase critical thinking skills and the ability of students to understand cause and effect in complex systems.

The findings also underscore the importance of school models being adjusted for the students, assisting in their academic growth, instead of being a one size fits all solution. Research literature shows that promotion of student directed learning has benefits for generation of critical thinking skills and creates confidence and the ability to think independently and support their classroom decisions (Wierman, 2022). I hope that this research will serve as a foundation for future scholarly endeavors in this area, and ensure that all students, regardless of their background, have access to high quality education.

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Biosketch

Tim Kennedy was born. He went to school. He wrote a dissertation. He graduated.