Toward achievement in the "Knowledge Economy" of the 21st Century: Preparing students through T-STEM academies

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ABSTRACT

Schools are constantly engaged in implementing reform strategies to prepare students for postsecondary education leading to their career choices. Challenges here involve education initiatives addressing programs not strategically planned, educators not prepared for transition, and no follow-up support beyond initial implementation stages. This study examined school reform initiatives by the Texas Science, Technology, Engineering, and Math academies toward better-quality instruction, to prepare students for post-secondary education, and in-turn, for the knowledge economy of the 21st century. The purpose of the study was to gauge the effectiveness of these academies in math, science, and engineering, and if these academies are successful educational-reform systems. Inductive data analysis was conducted from general program data and teacher interviews from one rural and one urban high school. Data were obtained through observations, interviews, and program documents. The coding system subdivided the data into domains to establish semantic relationship, and to uncover frames within the data. Terms under each domain served as parameters for each respective domain. The practice of member-checking, peer debriefing, and data triangulation ensured validity, and case study protocols established reliability of results. Results indicated that T-STEM academies have implemented educational reform strategies that produce better-prepared graduates for post-secondary education and perhaps students that are prepared for the knowledge economy. Implications of the study for social change include heighten awareness of effective instructional practices to increase student achievement, as well as contribute to future STEM development relative to economic trends.

Keywords: technology education, science education, online education, engineering education, math education, T-STEM

INTRODUCTION

Progress in education necessitates periodic school reform initiatives, particularly if economic markets demand changes. STEM academies demonstrate the changes taking place across the country and certainly in Texas. Completion of the first 21st century decade has launched a global competitiveness pace in financial markets that has initiated an instructional paradigm shift for teaching and learning. The onset of global economic demands sets the stage for implications regarding the future of education in the United States. Examples of arguments to change from the traditional 20th century educational instruction come from numerous people and institutions. Bill Gates, Chairman and Chief Software Architect of Microsoft Corporation, stated "When I compare our high schools to what I see when I'm traveling abroad, I am terrified for our workforce of tomorrow" (as cited by Mundy, 2005). This perspective by a globally revered persona epitomizes the situation faced by the United States in the highly competitive knowledge economy.

In an effort to address this issue, the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Act (COMPETES) authorized under the Department of Education, Title VI, intends to enhance teacher education through science, technology, engineering and math (STEM) fields and critical foreign languages. The state of Texas, with public and private educational dollars, has authorized the Texas High School Project (THSP) to oversee the implementation of this project. The T-STEM is now in its sixth year of implementation and is serving Texas students through T-STEM Academies and T-STEM Centers.

Definition of the Problem

In the late 1980s Asian economic markets accounted for the rise of the Nikkei index by 300% which raised a level of concern for the United States and the rest of the OCED countries. Right after this period, the United States began an economic period of growth while Japan was hit by a recession and high unemployment. By the turn of the century, the US found itself in the middle of a highly charged global competitive economic market. The globalization was fueled by the accessibility and affordability of technology. Thomas L. Friedman's (2005) book of *The World is Flat* illustrated how the convergence of ten forces (Berlin Wall, Netscape, Workflow, Open sourcing, Outsourcing, Offshoring, Supply Chaining, In-sourcing, Informing, and "The Steriods") are the ten forces rebalancing economic markets throughout the world. Friedman's work with these and other observations might be regarded as remaining largely outside academic inquiry, however his experiences and opinons have become popular across disciplines. The term globalization is used to describe the ease with which companies are able to collaborate world wide, becoming part of global supply chain. After the ten forces converged, Friedman states that businesses had to collaborate to innovative, as well as to create value for their companies. From a world view of school reform based on economic demands, studies ensue regarding the US.

Attention turned to the US schools when the Committee on Prospering in the Global Economy of the 21st Century released their findings, which recommended that action be taken in areas of science, technology, engineering, and math in order for US to remain competitive in the global market economy. Hanushek (2005) argued that a more educated society could lead to a higher rate of inventions. An educated populace would enable companies to introduce production methods with consideration of emerging technologies. External factors contributing to

educational outcomes would be the quality of schooling. Hanuschek suggested that improvement in our school systems could facilitate long-term economic gains.

From these reports, questions remain about the preparedness of US students to compete in the job markets of the 21st century. In response to these questions, STEM educaional intiatives have been implemented throughout the US to prepare students to meet economic challenges of the 21st century. In Texas, public and private dollars have been invested to help schools with intial start up costs to establish STEM academies and STEM centers. This educational initiative is Texas' efforts in reformulating secondary schools to prepare students in the areas of math, science, and engineering. It is the intent of our state and federal governments, by establishing STEM academies, to be in the forefront of ingenuity and creativity in order compete, prosper, and be secure in knowledge economy of the 21st century.

Often, educational intiatives struggle with unplanned startup programs, ill-prepared educators, or unavialable followup support beyond the intial implementation stage. Educational reforms also struggle when personnel do not agree with program goals. Argueably, real transformational change involves second order change as proposed by Cuban. Cuban (1987) classifies change into first-order and second-order categories. First-order change seeks to make the current way of doings things better; however, the changes could be reversed. Second-order change does things significantly or fundamentally different than previoulsy practiced. Such changes, though, require verification of issues in STEM academies, as reflected in this study.

This study verified school reformation content associated with two local STEM academies. The study identified the quality of coursework in preparing students for post-secondary education, as well as the knowledge economy. Hargreaves (2003) stated, "We live in a knowledge economy, a knowledge society. Knowledge economies are stimulated and driven by creativity and ingenuity. Knowledge-society schools have to create these qualitites; otherwise, their people and their nations will be left behind" (p.1). Such issues and questions are important in helping to underscore the need for Texas students to improve in math and science. The idea of STEM strategies raising student achievement in science and mathematics is an important issue, as is preparing the students for competitive markets of the knowledge economy. An inquiry to determine educational benefits associated with STEM academies will benefit educators seeking to reform their schools.

PURPOSE OF THE STUDY

The purpose of this case study was to determine the effectiveness of T-STEM academies as a successful educational change process when reforming schools; it also endeavored to determine the quality of instruction in the areas of math, science and engineering preparing students for post-secondary education. In addition, it examines the extent to which students are prepared to meet the challenges of the 21st century's knowledge economy.

Fullan's (2008) introduction outlines six steps in applying large-scale reform to organizations or whole systems. The six steps are to love your employees, connect peers with purpose, capacity building prevails, learning is the work, transparency rules, and systems. Essential tools to restructured schools are found in work by Dufour (2004, 2005), Ghere (2001), Schon (1983). These publications were used to cross reference the implementation of the STEM programs. Educational professionals also agree that reflective practice through a collaborative culture is a critical component for effective change. The practice of professional learning

communities is considered an integral part of reforming schools, and facilitates a quality education for students.

Among the final objectives of this study was an effort to identify the elements of the knowledge society, and the knowledge economy, as they pertain to the present global economy. The rapidly increasing technology access and affordability worldwide is beginning to have an effect on global economic markets and consequences relevant to the knowledge economy. In order for American economic markets to stay competitive, the attention to reform our schools is once again in the forefront of discussion. Our nation's economic concerns have invoked the need to produce an education for our students that fosters ingenuity and innovation. Ingenuity and innovation are considered the cornerstone of the knowledge economy, and the reason why STEM academies are in development stages.

METHOD

This study was intended to examine the effectiveness of T-STEM academies in south Texas. It incorporated a qualitative case study method designed to achieve a deep level of understanding related to the strengths and challenges these academies were experiencing in their implementation efforts.

Research Design and Questions

A case study design to focus on south Texas high schools that have instituted STEM academies to regionalize the in-depth data collected through observation, interviews, and program documents. Such collection methods facilitate the development of a descriptive framework of the participating STEM academies. The triangulated framework established patterns generating strength in the internal validity of the study which is correlated with the research questions. Creswell (2003) clarified this research design as an approach that investigates a bounded system over time through detail collection of data such as observations, interviews, and documents (p. 73). Grant documents and annual public information reports were reviewed and examined in addition to in-depth interviews with academy personnel.

The research questions below provided the foundation of the study by limiting the scope of the investigation and determining the satisfactory completion of the study (Hatch, 2002). Application of this research design helped answer the following research questions:

1. How are T-STEM academies meeting program goals of preparing South Texas students to compete in the job markets of the 21st century's "knowledege economy"?
2. How is the T-STEM academy curriculum in the areas of math and science more rigorous than state established standards?
3. How is the T-STEM academy preparing students for a postsecondary education?
4. What school reform strategies, if any, advocated by content experts are practiced by T-STEM academies?

The Site

The public school districts taking part in the qualitative case study design were well-suited for this study because both schools were funded since the inception of the state initiative,

along with their South Texas location. Permission from site administrators was obtained before the actual data were collected. The site administration was given a brief description of the study, purpose, and factors associated with their particular school district. After establishing a working relationship with the school districts, I concentrated on answering the research questions as it pertains to the two participating high schools.

This study focused on two Texas STEM academies. South Texas Village High School is located in the Rio Grande Valley, with a more urban academy at Coastal Bend High School. South Texas Village High School is a small rural school close to the Texas-Mexico border, and leadership launched the process of establishing their own high school after receiving a STEM academy grant. This unique situation added a different perspective to the study. Additionally, the small class sizes allowed for the entire high school student body to be a part of the STEM academy. In stark contrast, Coastal Bend High School is located in the economically vibrant port of Texas, and has a student body of over 1,800 students. Coastal Bend High School's grant application was restricted by grant requirements to serve a small learning community of 100 students per grade level. Both high schools were in their third year of funding, and serving as mentor sites for other high schools planning to set up their own STEM academies.

T-STEM academies program guidelines restrict the student population that can be served by this grant to those students in the sixth through twelfth grades. TEA released the T-STEM Start-up Cycle 4, RFA# 701-08-123, SAS # A231-09, which stated the following information regarding the population of the funded academies. "The T-STEM Academy must be small, serving approximately 100 students per grade" (p 12). In addition, the requirements of population served should place emphasis on students of low income, at-risk and/or those of first-generation college-goers. A mandatory requirement for this cycle of funding was that 40% of the students served had to be economically disadvantaged (p.12).

The performance-measure section of the grant application requires STEM academies to generate TAKS passing percentages, graduation rates, dropout rates, percentage of students enrolled in AP, IB, or dual credit courses, percentage of students taking PSAT, ACT, or SAT tests disaggregated by ethnicity and economically disadvantaged. In addition, STEM academies are required to track the percentage of students that acquire four years of high school math and science, percentage of students who participate in internships or capstone projects, and percentage of students who met with an academic advisor. The required performance measures parallel the intent of this study. Because the schools have the data readily available, the information thus augmented the reliability of this research.

Research Population

The school districts mentioned above were asked to provide general student achievement results, program documents, as well as asked to provide input regarding program outcomes through interviews and classroom observations as part of the research. During the data collection process, 10 teachers, and one academy coordinator assigned to the STEM academy participated from Coastal Bend High School. South Texas Village High School participants were seven teachers, a principal, and the superintendent of schools. I also utilized campus driven reports of student achievement results on the state TAKS test. Also, members of the academies were asked to review drafts of the study to provide feedback on the interviews, observations, campus achievement data, and program evaluative instruments.

Data Collection

At South Texas Village High School seven teachers, the principal, and Superintendent of Schools participated in the study's collection process. At a called staff meeting an explanation of the study's purpose was communicated to the staff, and consent forms disseminated. After the staff meeting permission was granted to copy documents pertaining to the STEM academy's program objectives. The program documents served as diagnostic tools to prepare for teacher interviews and classroom observations. Classroom observations and interviews were scheduled with campus administration to avoid interference with campus activities. With participants' consent, classroom observations were used to record teacher instructional delivery, as well as to document the implementation of program objectives. During the course of the interviews, a standard set of initial questions were used with additional curriculum-probing explorations to augment and secure pertinent data. Semi-structured interviews were conducted in one-hour intervals prearranged with campus administration. A tape recorder was used during interviews, along with field notes, to ensure accurate transcription of the conversations with participants. Creswell (1998) proposed the use of multiple sources of information in a case study which allows for triangulation of data to strengthen study validity (p.62). The findings were shared with staff members for their input before solidifying study results. This course of inquiry and data collection further ensured the validity and reliability of the study's results.

In contrast to the small rural high school at South Texas Village, Coastal Bend High School at Corpus Christi has a 90% Hispanic population, 69% economically disadvantaged, with 2% LEP students. According to STEM guidelines, the number of students in this academy was limited to no more than 100 students. Coastal Bend High School is required to maintain the same student subpopulation in their STEM academy as they do on their campus. The high school was not allowed to pick their more advanced students to participate in the STEM academy. A lottery of sorts, approved by TEA, was implemented to maintain the same student diversification in the STEM academy that is found in the general student population.

Coastal Bend High school had 14 teachers, one academy coordinator, and a vice-principal with STEM academy duties. A concerted effort was made to have 11 staff members participate in the study. The numbers were intended to be small and practical, to gain genuine results based on the establishment of professional working relationship with the participants. Staff members signed the consent form before participating in the study. On the first visit to Coastal Bend High School, the STEM coordinator copied program documents, and given to me for examination. Classroom observations and interviews were scheduled with campus administration to avoid disruption of campus activities. Classroom observations using a generic template were used to record teacher instructional delivery, as well as to document the implementation of program objectives. Due to teacher time constraints, the interview questions were given to the participating staff members to be answered on their own time. Follow-up questions were conducted and tape recorded on the same day of classroom observations. The findings were shared with staff members for their input before solidifying study results.

Data Analysis Procedures

The three-component flow model advocated by Miles (1994) to analyze and construct generalizations of the data retrieved during the research process was employed. These components are data reduction, data display, and conclusion drawing/verification. The data

collected in this study was based on the cooperation of site participants. In reference to collection of data Miles contends that some investigative actions are straightforward while others involve how people want others to see them, or impression management (p.10). Miles continues to elaborate that certain actions are influenced by the interpretation of the participants and the researcher. Careful consideration of the data analysis was made, to avoid influences on study results.

Data reduction continued through the research process that best suited the study outcomes. Miles (1994) suggests that data reduction sharpens sorts, focuses, discards, and organizes data to be able to draw conclusions (p. 11). Specific inductive analysis of the data is focused on the research questions that facilitated the categorical focal points of the study. An attempt to acquire salient data for each research question was made through documents, interviews, and observations. A thematic analysis of the cases was ensured after both sets of independent data were fully developed and cross-checked with participants. Hatch (2002)

The data was subdivided as domains to establish semantic relationships to uncover analytical frames within the data. The final step was to identify emerging theme(s) for the entire study. The data acquired through document reviews, interviews, and classroom observations are presented to answer the research questions using scholarly practices by implementing qualitative-research protocols.

Validity and Reliability

Validity of this study was secured by using peer-debriefing, member checking, and triangulation of collected data from the participating campuses' annual campus-wide student achievement, observations, grant documents and interviews to answer the research questions. Moreover, peer-briefing practices were used as a means of helping to validate data. Triangulated multiple sources of information verified through member-checking and peer debriefing establishes a chain of evidence corroborated by program participants, helping to ensure validity (Yin, 2009). The study relied on validity of the participants' interviews, and documents, subsequent analysis, and presentation of the data. Such data is of the type class and category as to be called that of having face value. Face validity is solely how the documents, interviews, etc., appear, and not dependent on established theories or other validity for support. Ultimately, the goal of this study regarding its validity is for the scholarship here described to help make possible the application of sound judgments.

Reliability of a study is rated by the instrument's consistency in measuring and repeating the same results if the subjects are tested elsewhere or at a different time under the same conditions. In laymen's terms, do you get the same test results every time you conduct the test under the same conditions? Public information such as state Academic Excellence Indicator System (AEIS) Reports, TAKS (state exam) with a Kuder-Richardson Formula 20, grant applications, program evaluation instruments, flyers, memoranda of understanding, class schedules, state test results, curriculum documents, extended learning schedules, and a myriad of other documents served as the case study database helping to insure reliability (Yin, 2009). This concept is common in many forms of empirical inquiry—consistency of measurement, repeatedly. This measuring process should reflect and reveal a pattern of interest, and even conclusive evidence suitable for definitive evaluation.

RESULTS

Data were validated through member-checking, peer-debriefing, and triangulation. In addition, the multiple sources of public information served as a database supporting the reliability of study results. The convergence of triangulated evidence established patterns within the data, thereby formulating theme(s) based on this investigative research. The findings of this research are intended to contribute to a larger body of knowledge, as well as to help contribute to social change through education.

Summary of Findings

The first research question asked, "How are T-STEM academies meeting program goals of preparing South Texas students to compete in the job markets of the 21st century's knowledge economy?" In answer to this question both academies maintained the position that college preparedness, advance placement classes, as well as extended learning opportunities were contributing factors in preparing students for the 21st century. Both academies have taken steps to ensure a college-going climate at their campuses through memoranda of understanding with area colleges. In addition, the academies actively encourage students to participate in ACT/SAT preparatory classes, dual-credit courses, and college courses. A big component of the academies is to maintain a close working relationship with area businesses and industry to offer students real-world connections to their studies. These experiences include internships, site-visits, guess speakers, and direct industry skill-related awareness promoting student interactive participation culminating in project-based learning projects. The academies have made strides in preparing their students for, and offering the students, post-secondary courses. This effort is summed up by a South Texas Village High School teacher who stated:

> I know that they [academy students] have a lot of dual enrollment, concurrent enrollment, and distance learning, which is a tremendous asset. These kids get to their first year of college and they are already at the sophomore level. This is a tremendous advantage. The students will be better prepared to function in society or function at a higher level of jobs or careers. They will be better equipped for the business world.

Teachers at both campuses conveyed that their campuses were preparing students for the job markets of the 21st century by enrolling students in post-secondary institutions.

The second question asked, "How is the T-STEM academy curriculum in the areas of math and science more rigorous then state established standards?" The findings revealed that both campuses require students to have four years of science and math along with more enrollment opportunities in both areas of study. The academies do differ in the type of classes used to enhance the rigor of regular high school curriculum. The Innovation Academy at Coastal Bend High School incorporates Project Lead the Way (PLTW) along with Advance Placement (AP) courses to increase the rigor of their high school curriculum. One Coastal Bend High School teacher stated, "The curriculum that we are using is PLTW is project-based instruction that makes students generate a product . . . it is very attractive [PLTW] to school districts because of the rigor and relevance in the curriculum." Presently, the academy is looking to strengthen the college dual-enrollment opportunities for their students. South Texas Village ISD

STEM Academy mirrors Coastal Bend High School in the promotion of PreAP courses for students; however, this academy is a big proponent of college instruction during the high school years. It has been discussed before that 100% of the sophomores and juniors are taking college courses. Both academies are providing real-world applications for their studies by the introduction of extended learning opportunities for the students.

Research question three examined the issue of preparing students for post-secondary education. The findings reveal extensive efforts at both STEM academies are underway to formulate college-readiness conditions for all students. As discussed above, at South Texas Village STEM Academy 100% of their student body are enrolled or being prepared to enroll in college courses. Not to be left behind, the Innovation Academy has 100% of its students taking advanced placement classes in which students can test for college credit. In addition, the Innovation Academy is waiting to be certified by The University of Texas at Tyler in PLTW to qualify their students for additional college credit. Staff members at both academies have obtained key partnerships with area colleges, universities, and private industry that endorse the early college concept for those students. Expressing the sentiment of staff members about the effectiveness of preparing students for post-secondary success, one South Texas Village teacher stated, "Everything is given to them [students] all the books, tuition, and travel. The students will be ready for that level of coursework." Both academies have established memoranda of understanding with numerous universities and/or colleges to secure college credit courses for their students.

The last research question asks, "What school reform strategies, if any, advocated by content experts are practiced by T-STEM academies?" The source of inquiry centered on teacher capacity, the connection of peers with purpose, and rigorous instruction. In addition, the study investigated opertional-definition areas associated with school-reform strategies as advocated by the T-STEM initiative. The intiatives in condensed form include the following: (a) developing STEM literate graduates, (b) agreements with institutuions of higher learning and other partners, (c) recruiting key personnel with STEM subject-matter knowledge, and (d) on-going formative evaluations of the program.

An overview of this research question uncovered that both academies support increased teacher capacity through staff development, schedule collaboration meetings, creation of a college-going atmosphere, provisions for real-world applications through extended learning experiences, and establishing partnerships—all to bolster school reform. A template of school reform strategies reflecting the work of leaders such as Defour, Fullan, Marzano and others identified decisive factors essential to school reform. The factors identified as school-reform strategies (Appendix A) can be linked to strategies implemented by the academies; thereby, assumptions can be made that the academies have taken measures to reform the educational base. To better explain this, descriptive outcomes pertaining to the school reform effots by these T-STEM academies is covered in depth in the interpretation-of-findings section below.

Interpretation of Findings

Interpretation of Findings: Research Question 1

"How are T-STEM academies meeting program goals of preparing South Texas students to compete in the job markets of the 21st century's knowledge economy?"

Based on the literature review from chapter 2, as well as throughout the previous chapters, the preparation of students to meet the challenges of the 21st century is difficult to

pinpoint as a set of conclusive strategies. This study approached this research question with the understanding that a general-perspective approach was better suited than a prescriptive set of conditions.

On the one hand, it is difficult to assert if the academies offer a global work-based perspective in the curriculum because of the complexities of this issue. On the other hand, both academies have established a close working relationship with area business, industry, post-secondary institutions to provide relevant work-based experiences and scholarly preparation for the students. If local industries and universities have the pulse of the 21st century global workforce, it can be assumed that both academies are preparing students for the job markets of the 21st century's "knowledge economy." In addition, it has been well documented with strong supporting evidence that both academies have provided STEM-focused training for the students. Furthermore, program documents accentuate that academy students are engaged in their personal growth through participation in internships, field-work experiences, and extended learning opportunities possibly laying a strong foundation for economic success. The development of personal skills leading to economic success is a proposition introduced previously and supported by Eric Hanushek (2005) with statements such as, "The human capital of the population, which is enhanced by a strong education system, enters directly and indirectly into economic growth." In this respect the academies are preparing students for the workforce of the 21st century.

Interpretation of Findings: Research Question 2

"How is the T-STEM academy curriculum in the areas of math and science more rigorous?"

The academies' class schedules verify the established practice of offering additional math and science classes beyond high school graduation requirements. It was further revealed that students were enrolled in math courses for college credit, or participated in preparatory engineering courses. For example, the Innovation Academy students are enrolled in Project Lead The Way (PLTW) courses that are recognized nationally for outstanding curricular structure in the engineering field. The South Texas Village STEM Academy depends on area colleges and universities to provide college courses to supplement their math and science curriculum. Both academies have made strides to meet the challenges set by The National Commission on Mathematics and Science Teaching for the 21st Century as reported in *Before It's Too Late* (2000). The report stated "the Commission is convinced that the future well-being of our nation and people depends not just on how well we educate our children generally, but on how well we educate them in mathematics and science specifically" (p.4). The STEM academies did express their commitment to continue the practice of continuing the practice of offering challenging coursework in the areas of math and science.

To augment instruction, the academies have worked with the T-STEM center housed in the Educational Service Center 1 (ESC 1) located at Edinburg, Texas. Because of the geographical proximity of the South Texas Village STEM academy to ESC 1, this academy uses the STEM center for teacher training more so than the Innovation Academy of Coastal Bend High School. Over the past two years the South Texas Village STEM academy has used the services of ESC 1 over 12 times. During the same time period, the Innovation Academy has used ESC 1 sparingly as a teacher-training resource. This does not mean that the Innovation Academy is not providing training for teachers, but to the contrary, the academy supplements teacher training by other means.

Interpretation of Findings: Research Question 3

"How is the T-STEM academy preparing students for a postsecondary education?"

The operational definitions listed with this research question include the following: (a) plan for student success of college entrance exams, (b) offering students college-level courses, (c) students graduating with 12 to 30 college-credit hours, (d) academy graduates prepared to pursue postsecondary STEM fields, and securing memoranda of understanding with colleges or universities. By Maximizing local resources and grant funds, the academies are working toward 100% of their students to be enrolled in dual-credit courses, or concurrent credit with area colleges and/or universities. The data validates that preparing academy students for post-secondary is a strong attribute of both academies. The preparation of academy students for successful completion of post-secondary courses may not be in question; what could be in question is the acquiring of a postsecondary degree especially in the STEM areas. This study does not intend to examine the latter. The data associated with this research question confirms that the academies are meeting the STEM program intent of preparing students for a postsecondary education by establishing memoranda of understanding with colleges and/or universities to provide dual-credit college courses. In addition, the academies have taken extensive measures to prepare students to meet college entrance requirements using different avenues. The academies are providing transportation, covering tuition fees, offering AP courses for college credit, certifying the campus as an ACT/SAT exam site, providing college entrance-exam tutorials, and providing distance-learning college classes. It is the goal of both academies to graduate students from the academies with at least 12, and up to 60, college hours.

By establishing and promoting a college-going climate, the academies have made decisive strides toward meeting positions stressed by Hanushek (2005) that formal schooling is one of several skill contributions of an individual, and to human capital. Findings, thus, in this study, reflect that academy students will have foundational skills to be successful in a post-secondary environment.

Interpretation of Findings: Research Question 4

"What school reform strategies, if any, advocated by content experts are practiced by the T-STEM academies?"

To narrow the focus of this broad category, I focused the study on teacher capacity, connection of peers with purpose, and rigorous instruction. Both academies relied heavily on increasing the teachers' capacity by providing extensive and relevant staff development. South Texas Village STEM Academy's concerted teacher staff-development efforts are, for the most part, in collaboration with the STEM Center at Edinburg, Texas. In addition, the academy improved instructional delivery by contracting with other agencies. The Innovation Academy contracted staff development with various organizations that included training in PLTW, AVID, Project Based Learning, Advance Placement, and assorted teacher instructional-delivery methods. Data revealed that both academies understood the necessity of investing a big portion of their budgets in the area of teacher development in STEM, as well as other areas. The report, *Before It's Too Late* (2000), introduced in previous chapters, recommends the reshaping of staff development to promote high-quality teaching as a school-reform strategy (page 22). The

investment in staff development, and setting a collaborative structure has contributed to a change in the instructional-delivery methods utilized by the teachers in both academies.

Both academies rely heavily on allowing teachers to collaborate during the school day to improve on classroom instruction, subsequently student achievement. The collaboration meetings may be organized by subject matter, grade level, or whole-group discussions. The concept of peer collaboration is considered by Dufour (2005), Marzano (2003), and Fullan (2007) as a school-reform strategy. Their thoughts on this issue are presented in Chapter 2 of this study. As an example of this endorsement, Dufour (2005) stated, "Educators must develop a deeper, shared knowledge of learning-community concepts and practices, and then must demonstrate the discipline to apply those concepts and practices in their own settings if their schools are to be transformed" (p. 10). The academies' work on establishing a collaborative culture, and the increased capacity of teachers, has favorably influenced student achievement. Finally, the investment by the academies in increasing teacher capacity and establishing a professional collaboration environment has resulted in an atmosphere of instructional rigor. Comparatively, the academies are preparing their students, more so than standard high schools, by providing students with college courses while still enrolled in high school.

CONCLUSIONS

Predicting the job markets of the future is, at best, a calculated risk, and, at worst, a roll of the dice. This qualitative case-study endeavored to determine the efforts of Texas-Science, Technology, Engineering, and Math (T-STEM) academies as agents of change in preparing students for the future job markets of the 21st century's knowledge economy. The study has not fully determined the outcome of the preparatory efforts; however, it serves to document the school-reform efforts underway at these T-STEM academies. Along with underlying support, these academies are providing an academic foundation based on post-secondary preparation, and real-world field experiences.

Close examination of the program data revealed that these academies are accomplishing grant objectives, and attempting to provide students with an educational foundation to succeed in the knowledge economy. Zhao (2009) challenged educational systems to help students to secure a job, and for students to interact with other cultures to develop a sense of globalization (p.110). It appears that the STEM academies are helping students to have a chance of being financially stable by providing them with challenging high school experiences, as well as college-readiness opportunities. Additional challenges proposed by Zhao included preparing children to interact with other cultures, and developing senses of global citizenship [neither being readily evident in my study] (p. 112). Job markets of the future remain a challenge to predict by economic experts; however, school leaders are exploring different ideas to help in this endeavor.

An additional discovery worth mentioning here is the importance of strong, forward-thinking, dedicated, and stable leadership to accomplish school reform. Meris Stansbury, associate editor for *e*School News (2009), wrote an article titled *School of the Future*. The article mentions that in 2006 the Philadelphia school system opened the School of the Future (SOF). That SOF was supported by Microsoft, a company that is well known as a visionary leading company in the technology arena. After three years the SOF failed. The underlying cause of the failure was the turnover rate of the leadership. I am of the opinion that if schools—in this case the STEM academies—do not retain teaching staffs, severe loss is felt, but the campus leadership

will help to recover the loss. In contrast, the STEM academy or educational system may not recover if the leadership is lost. Leadership development and retention is important for any school system contemplating school reform.

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APPENDIX

School Reform Strategies
(Advocated by Field Experts and Organizations)

(Survey-Matrix)

Reform Strategy	Fullan	Dufour	Marzano	TEA	Metiri Group	*Partnership
New Materials	√					
Teacher Capacity	√		√	√	√	√
Change in Beliefs	√					
Love Your Employees	√					
Connect Peers with Purpose(PLC)	√	√	√			
Program Transparency	√		√	√		
Defined Goals	√			√		
Rigorous Instruction	√		√	√	√	√
Global 21st Century Awareness				√	√	√
Continuity and Sustainability	√		√	√		

. . . some select contemporary topics in education-reform research and commentary . . . .

*Partnership for 21st Century Skills