RESOURCE ALLOCATION EFFICIENCY AT THE ELEMENTARY AND MIDDLE SCHOOL LEVELS IN A TEXAS SCHOOL DISTRICT

Lance Hamlin, B.S., M.Ed.

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APPROVED:

Jimmy Byrd, Major Professor
James Laney, Minor Professor
John Brooks, Committee Member
Linda Stromberg, Committee Member
Nancy Nelson, Chair of the Department of Teacher Education and Administration
Jerry Thomas, Dean of the College of Education
Mark Wardell, Dean of the Toulouse Graduate School
In recent years much attention has gone to school efficiency, as determined by assessing student achievement relative to expenditures at the school district level. The present study built on prior work in school efficiency with a focus on the school campus level instead of the district level. Included in the study were 28 elementary and middle school campuses in a selected school district in Texas. The approach taken in the investigation was data envelopment analysis (DEA), which provided scores for efficiency and was intended to provide clarity on efficiency research at the campus level. Past studies using the DEA model have involved business and private institutions, but not public schools.

The DEA model calculated and assigned efficiency scores for each campuses. The two variable categories used to determine campus efficiency were student demographics and resource allocation. The total enrollment numbers included the number of White, economically disadvantaged, at-risk, and limited English proficiency students. The resource allocation variables included the total expenditures in instruction, instructional related services, instructional leadership, campus leadership, and student support services. The efficiency scores paired with student achievement scores determined campus efficiency and effectiveness. An effective and efficiency framework was used to represent the data with student achievement on the y-axis and campus efficiency scores on the x-axis.

I applied Pearson product moment and regression analyses using the same variables as previous studies. The Pearson product moment assessed the correlation between student demographic variables, function code variables, and campus efficiency. The Pearson product
showed a weak positive relationship between the number of White students and the number of LEP students enrolled in the district. The analysis also showed moderate and strong negative relationships between efficiency and instructional leadership and student support services. The regression analysis identified the student demographic and function code variables that affected the level of efficiency of each school campus. School leadership and student support services had strong negative relationships with campus efficiency. Instructional related services had a strong positive relationship, and total enrollment and White students had weak positive relationships with efficiency. Additionally, non-White, economically disadvantaged, and at-risk students yielded weak to moderate negative relationships. The use of the DEA model allows school districts to analyze the spending patterns, specifically at the campus level. This analysis also allows districts and campuses to make meaningful decisions related to classroom instruction, instructional leadership, campus leadership, and counseling services.
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CHAPTER 1

INTRODUCTION

State and local governments across the United States have consistently struggled to find efficient ways to spend money on education and improve student achievement at the same time. Districts throughout the state of Texas have had to learn to do more with less. Researchers and school administrators have examined how school districts allocate their resources in ways that positively affect student achievement. Specifically, research has examined resource allocation of school districts in multiple states with an emphasis on the state of Texas (Pan & Rudo, 2003). Researchers have explored the topic of resource allocation for more than 50 years with no true conclusions. The results from a number of studies differ across the board. Some studies support each other, while others provide differing opinions; however, resource allocation will likely be of interest to policy makers for many years to come.

The following review provides a detailed examination of the historical relationship between resource allocation and student achievement, and the importance of allocating resources efficiently. This discussion includes strategies used by different states to address resource allocation, with an emphasis on resource allocation and student achievement in Texas and possible solutions for this national concern. The focus of this study was on the methods that a selected school district in Texas used to allocate resources efficiently while providing high student achievement.

Texas school districts use state-mandated assessments to determine the level of student achievement. The Texas Education Agency (TEA) implements assessments of public school students’ knowledge and skills under obligation of state law. The assessments used on elementary campuses include reading and mathematics for third through fifth grades and an
additional writing test in the fourth grade and science test in the fifth grade. In middle school, student assessments include reading and mathematics in sixth through eighth grade and an additional writing assessment in seventh grade and social studies and science assessments in eighth grade.

Over the years, the state assessment system has gone through numerous name changes including the Texas Assessment of Basic Skills (TABS), the Texas Educational Assessment of Minimum Skills (TEAMS), the Texas Assessment of Academic Skills (TAAS), Texas Assessment of Knowledge and Skills (TAKS), and currently the State of Texas Assessment of Academic Readiness (STAAR). The state of Texas spends millions of dollars each year on state-mandated assessments that will continue to be a part of school district budgets as long as the state provides funding for education (Carter, 2012). The tools used to determine the level of effectiveness and efficiency of a district include the data envelopment analysis (DEA) and stochastic frontier analysis (SFA).

Efficiency Models

Data Envelopment Analysis (DEA)

The DEA is a widely applied linear programming-based technique with the primary purpose of evaluating the efficiency of a set of decision-making units (DMU). Educational leaders use the DEA primarily for its numerous advantages, which include the following:

- Allows inputs and outputs to be expressed in different units of measurement
- Does not require the assumption of a functional form that relates inputs to outputs
- Directly compares DMUs or schools against peers or a group of peers
• Forms the efficient frontier from the efficient and inefficient units enveloped by the frontier to provide information on a school’s improvement potential (Byrd, Daggett, Silver, & Williams, 2011)

Stochastic Frontier Analysis (SFA)

Educational leaders use the SFA model to calculate and provide insight and verification of the DEA analysis. This approach uses econometric techniques and imposes a priori the functional form for the frontier and distribution of efficiency (Byrd et al., 2011). The importance of creating an educational funding system that is efficient is not a new among Texas citizens. In fact, the Texas Constitution states the following:

A general diffusion of knowledge being essential to the preservation of the liberties and rights of the people, it shall be the duty of the Legislature of the State to establish and make suitable provision for the support and maintenance of an efficient system of public free schools. (Article 7, Section 1)

Education has always been part of the foundation of Texas; however, 170 years after the Texas Constitution was written, the state continues to struggle with finding a funding system that helps school districts allocate resources efficiently and ensure positive student achievement.

Texas public education is facing perhaps its most challenging academic and economic challenge in modern history. In 2010-2011, Texas’ public education expenditures accounted for 41.4% of all state appropriations, approximately 80% of which were allocated to employee salaries and benefits. Recent media reports predict a loss of as many as 100,000 teaching and administrative support positions before 2014 as a way to help balance the state budget (Byrd et al., 2011). Therefore, public schools throughout Texas must determine how to deal with declining resources while continuing to push toward improved student performance. The decline
in available resources, in particular, makes the various support systems, organizational structures, and strategies to improve student performance difficult to manage (Daggett, 2009).

District leaders have stated that some or all of the following changes will result from the proposed budget cuts:

- A reduction in custodians and maintenance crews
- The elimination of safety officers
- A decrease in special education services
- Cuts to central office and technology personnel
- Defunding extracurricular activities
- The implementation of tiered scheduling
- The closure of some schools for consolidation within districts
- The elimination and consolidation of some teaching and administrative positions

The state will base many of these budget cuts on inaccurate or incomplete data, which suggests that reductions will be uniform across areas without a clear rationale tied to actual student performance (Byrd et al., 2011). These concerns place value on the importance of researching individual production codes when allocating resources. Production-function codes are categories that school systems use to identify educational expenditures. Considering the potential for inaccuracies, I developed the following research question: Can an efficiency model be used to help school districts identify discretionary and nondiscretionary resources that affect student achievement?

It is extremely important for Texas school district leaders to understand what it takes to be effective and efficient in terms of resource allocation and student achievement. Districts and campuses struggle to obtain academic goals effectively while allocating and spending financial
resources efficiently. Table 1 provides a breakdown of the production-function codes used within school districts nationwide.

Table 1

*Production-Function Codes*

<table>
<thead>
<tr>
<th>Function</th>
<th>Function Title</th>
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<tr>
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<td>Instructional Resources &amp; Media Services</td>
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Adapted from TEA (2010a).

**Research Problem**

The research problem of focus in this study was two-fold: (1) use the DEA and SFA models to describe the efficiency and inefficiency of resource allocation in a selected Texas school district and (2) determine the effect that resource allocation has on efficiency and student achievement based on DEA and SFA data analyses. The state of Texas expects districts to accomplish more with less, which forces individual districts to focus on critical needs to assess efficiency using information from the Academic Excellence Indicator System (AEIS), which is a database implemented and maintained by the TEA.

**Purpose of Study**

The core purpose of this study was to use an efficiency model to help school districts become more efficient in the area of resource allocation while maintaining high student achievement. The purpose of the study was two-fold:

- Provide administrators, stakeholders, community members, and taxpayers near real-time data regarding district- and campus-level resource allocation efficiency or inefficiency.
• Provide administrators, stakeholders, community members, and taxpayers near real-time data regarding district- and campus-level effectiveness or ineffectiveness related to student achievement.

Research Questions

The following research questions guided this study:

1. What is the status of efficient or inefficient resource allocation in a selected school district in Texas?
2. What is the effect of the DEA and SFA efficiency models on student achievement in a selected school district in Texas?

Significance of Study

This study is important for several reasons. While Texas continues to reduce funding allocated for education, it also increases expectations of student achievement on state assessments. Therefore, educational leaders and stakeholders need to know whether a relationship exists between the amount of money spent on education and the level of student achievement as measured on state assessments.

Decades of research have failed to conclude whether a significant relationship exists between resource allocation and student achievement. Additionally, districts that do not use the DEA system are unable to predict the effects of budget cuts accurately or evaluate initiatives at the school level. As a result, this study provides leaders with information concerning the challenges that districts face. The DEA approach can assist schools and districts with data from in-district data systems in a real, or near real, time to assess the effectiveness and efficiency of schools, programs, personnel, and practices at the classroom-, teacher-, campus-, and district-levels. This study also provides evidence of the effect of implementing the DEA and SFA
models on a specific campus while comparing all campuses within a selected school district in Texas.

The DEA draws data from all district source systems including student information, assessment, human resources, finance, and school facilities systems. Using multiple regression analysis, the DEA analyzes the overall performance at the classroom-, school-, and district-levels. If a relationship exists between resource allocation and student achievement, policymakers, courts, and school administrators can use these findings to develop a resource allocation efficiency model for all school districts in Texas.

Definition of Terms

*Academic Excellence Indicator System (AEIS).* The AEIS is a comprehensive school performance and accountability reporting system for Texas public schools (Helvey, 2006).

*Accountability.* Accountability is assessed using a comprehensive system to establish academic performance standards and assessment, and includes the assignment of consequences to schools for nonperformance (Gibson, 2009).

*As-risk students.* At-risk students are those in public schools who are at risk of dropping out based on one of the following criteria:

1. A student who fails to meet the cut-off scores determined by the home district on a readiness assessment given in Grades PK-3
2. A student in Grades 7-12 who does not pass two or more core subjects at any time during the semester
3. A student who was retained in a grade
4. A student who fails to meet a state assessment cut-off score given during the current or preceding year
5. A student who is pregnant or is a parent
6. A student who is placed in DAEP during the current or preceding school year
7. Student who is expelled from school
8. Student who is placed on probation
9. A student who was previously reported as a dropout
10. A limited English proficient (LEP) student
11. A student in the custody of, care of, or referred to the Department of Protective and Regulatory Services
12. A student who meets the federal homeless criteria
13. A student who resides in a residential facility and the school learns of that placement

Central administration. Central administration refers to the costs associated with district-level administrative support (Carter, 2012).

Data envelopment analysis (DEA). The DEA is a method used to measure technical efficiency based on efficiency scores that form a boundary or barrier comprised of the most efficient scores. The boundary encompasses all other scores within the dataset (Carter, 2012).

Decision-making unit (DMU). The DMU is the subject of observation to determine technical efficiency and is expressed with a label (Carter, 2012). For this study, each DMU is an elementary and middle school campus in a Texas school district.

Discretionary factors. Discretionary factors are controlled by the management of each DMU and vary at the discretion of that DMU.

Economically disadvantaged. Economically disadvantaged refers to students who qualify for free or reduced price lunch. This qualification requires parents to complete paperwork that
attests to their household incomes. Economically disadvantaged is also referred to as low socioeconomic status (SES) (Gibson, 2009).

*Expenditures per pupil.* For every Texas public school district, the AEIS records an average number of dollars spent during each school year per student. This dollar amount indicates the average cost to the school district to educate one student (Carter, 2012).

*Instruction.* Instruction refers to activities related to expenditures that are necessary to educate students in the classroom (Carter, 2012).

*Instructional leadership.* Instructional leadership refers to funds directly used to manage, direct, supervise, and provide leadership in the area of instruction (Carter, 2012).

*Instructional-related services.* Instructional-related services are expenditures and expenses used directly and exclusively for curriculum, in-service training, and other staff development for instructional-related personnel functions (Carter, 2012).

*Low SES.* Low SES is the student subgroup defined by those who qualify for the free and reduced price lunch program. Low SES is also referred to as economically disadvantaged (Gibson, 2009).

*National Assessment of Educational Progress (NAEP).* The NAEP is also known as the Nation’s Report Card and is used assess student achievement in the United States across multiple content areas (Helvey, 2006).

*Nondiscretionary factors.* Nondiscretionary factors are outside the control of DMUs.

*Production function.* Production function refers to research studies that employ statistical methods to determine the relationship between inputs and outputs.

*School leadership.* School leadership covers activities related to directing, managing, and supervising schools (e.g., campus principal’s office and related costs) (Carter, 2012).
**Stochastic frontier analysis (SFA).** The SFA refers to a body of statistical analysis techniques used to estimate production or cost functions in economics while it explicitly accounts for the existence of firm inefficiency.

**Student enrollment.** The variable student enrollment represents the actual number of students enrolled in the school district in all grades (Carter, 2012).

**Student percentage passing TAKS.** The dependent variable student percentage passing TAKS reflects the percentage of assessments passed by all students on all assessments for each school district. Students in Grades 3-11 take the TAKS (Carter, 2012).

**Student support services.** Student support services include the three main budgeting areas of guidance, counseling, and evaluation services (Carter, 2012).

**Student-to-teacher ratio.** The student-to-teacher ratio is the number of students per teacher (Gibson, 2009).

**Technical efficiency.** Technical efficiency is a score that ranges from 0 to 1 and indicates the ratio of output gleaned from inputs. A score of 1 equals absolute efficiency (Carter, 2012).

**Texas Assessment of Knowledge and Skills (TAKS).** The TAKS is a comprehensive assessment used to determine what students have learned and understand, and assesses whether they can apply the concepts and skills expected at each grade level tested (Helvey, 2006).

**Texas Education Agency (TEA).** The TEA is the statewide regulatory body for K-12 public schools in Texas (Gibson, 2009).

**Limitations**

I obtained that data for the study from publically accessible databases maintained by the TEA website. Data represented elementary and middle school campuses from a selected school district in Texas based on specific categories pertaining to personnel, students, and finances.
CHAPTER 2
LITERATURE REVIEW

The U.S. educational system has experienced resource allocation concerns for the past century; however, this issue has received little attention until the past few years. A well-known report by the National Commission on Excellence in Education (NCEE, 1983), *A Nation at Risk*, is a great example of the lack of understanding regarding resource allocation in public schools. This report was the catalyst for a greater interest in the country’s educational system as it called for more resources to be devoted to the educational system; however, it did not consider the deep history of the nation’s educational spending patterns (Hanushek & Rivkin, 1997).

Researchers have conducted expenditure analyses to provided evidence of the breakdown of school costs. Findings have yielded four factor groups, (1) student enrollment, (2) instructional staff per pupil, (3) cost of instructional staff, and (4) other spending such as special education and teachers’ salary raises (Hanushek & Rivkin, 1997). Examining the data this way, researchers have identified resource trends in schools, determined drivers of these trends, and developed a foundation to assess the changes these expenditures create in the school setting.

For the past several years, the focus within the state of Texas has been on academic achievement of school districts and individual campuses. The intense focus on academic achievement has not changed, but it must share the spotlight with financial accountability. This new-shared focus is important considering that the state of Texas spends over $55 billion a year on education, which has doubled over the past 12 years (Byrd et al., 2011). At the time of this study, the selected district had a general fund budget of $200 million and spent approximately $116 million on classroom instruction (Texas Education Agency [TEA], 2011).
In examining the history of educational expenditures, it becomes evident that the cost of education has increased rapidly over the past 100 years. From 1890-1990, the cost of education increased from $2 billion to over $187 billion. Researchers have linked this increase to many causes; the two most popular are the increase in student enrollment and the increase in per student expenditures. For example, in 1890, the cost of educating one child per year was $164; in 1940, it was $772; and in 1990, it was $4,622. Therefore, the cost of education per child quintupled over each 50-year period (Hanushek & Rivkin, 1997).

Hanushek and Rivkin (1997) created the following three periods of emphasis in the history of educational financing: the Great Expansion (1890-1940), the Baby Boom (1940-1970), and the Great Intensification (1970-1990). The first 50 years, the Great Expansion, included a rapidly increasing school-age population that accounted for one-third of the $11 billion increase in teachers’ salaries. Student enrollment rates increased from 68.4% to 80.7%, which yielded an overall increase of 12.7 million students during this period.

The second 50-year period, the Baby-Boom, provided similar increases in student enrollment of approximately 20 million additional students. During this time, the cost of instructional staff increased from $83 to $155 per day, which yielded the largest effect on the increase in school expenditures of the three periods. Despite the increase in the number of students, the student-teacher ratio decreased from 28:1 to 20:5 during this period, which was a result of an increase of teachers, not other staff.

The last period, the Great Intensification, showed a significant decline in student enrollment by about 5 million students. Research attributes the cause of this decrease to a decline in the school-age population. Despite the decrease in the student enrollment, total
expenditures increased and contributed to the increase of staff costs by $40 per day, which created significant financial pressure on school districts.

Hanushek and Rivkin (1997) provided important information on the influence of resource allocation on student enrollment and identified an expenditure pattern that has existed since 1890. This evidence includes the (1) increasing cost of instructional staff, (2) declining pupil-teacher and pupil-staff ratios, and (3) increasing non-instructional staff costs. The history of resource allocation provides valuable information regarding past allocation and allows decision makers to predict future allocations. The federal courts have also provided guidance in the area of school funding; specifically, with the *Serrano v. Priest* (1971) decision when the responsibility of educational funding shifted to individual states. This court case changed how states, districts, and administrators work with legislators regarding school funding formulas and it increased educators’ concerns of the adequacy of educational funding (Gibson, 2009). The following section sheds additional light on the differences in the nation’s resource allocation patterns from state to state.

### State Comparisons of Resource Allocation and Student Achievement

Nationally, it costs approximately $110,000 to educate a child from first grade to 12th grade (Lips, Watkins, & Fleming, 2008). This cost alone should force educational leaders to create systems where a positive relationship exists between resource allocation and student achievement. States and districts often create patterns of resource allocation tied to student achievement. Several researchers have studied resource allocation patterns and student achievement across multiple states including Arkansas, Louisiana, New Mexico, Ohio, and Texas (Baker, 2009; Pan & Rudo, 2003). The results of these studies show significant relationships between resource allocation and student achievement (Baker, 2009; Pan & Rudo,
Evidence gathered from multiple studies demonstrates that high-performing districts have different spending patterns compared to low-performing districts (Pan & Rudo, 2003).

High-performing districts typically spend more on instruction per pupil and employ more teachers (Pan & Rudo, 2003). Baker (2009) supported these connections by asking school districts in Texas and Ohio the following three questions: (1) Are per pupil expenditures more predictable as a function of student needs? (2) Can empirical analysis guide the development of a rational resource allocation formula that targets money to higher needs schools?, and (3) Are school districts in reasonable financial positions to target resources according to need estimates? Leaders must answer these questions prior to allocating educational dollars. However, the vast range in the way states spend money on educational resources across districts makes it difficult to determine whether resource allocation is equitable. Some researchers believe that children’s access to student resources is not determined by their districts, but by the schools they attend (Roza, Guin, Gross, & Deburgomaster, 2007). For example, schools with a higher percentage of low-income students tend to receive more funds and more staff; however, staff usually lacks teaching experience (Baker, 2009).

Another important part of educational finances is teachers’ beliefs about resource allocation within their districts. Rudo (2002) examined school districts in Louisiana and New Mexico and found that 85% of the teaching staff believed that resource allocation in their respective districts was based on increasing student achievement. Additionally, 63% of teachers believed that resource allocation was based on student needs. When teachers answered questions about the specifics of resource allocation, 78% responded that money was spent on technology, and 57% believed that money was spent on staff development. Once again, there is an obvious
lack of understanding among administrators and teachers concerning how districts and schools make resource allocation decisions.

Resource Allocation and Student Achievement in Texas Public Schools

The current financial state of Texas public education offers an intriguing look at resource allocation and student achievement. Data collected by the TEA provide important information on resource allocation patterns among high-performing districts, school administrators’ characterizations of budget and resource decisions, and differences in these characteristics between high- and low-performing districts (Alexander et al., 2000). The Equity Center supported the supposition that several areas of the educational system positively affect student achievement if implemented appropriately. These areas include effective teachers, small class sizes, prekindergarten, interventions for struggling students, rigorous curriculum, and appropriate learning materials (e.g., technology) (Lesley, 2010).

Effective teachers are the number one factor in student success. The best way to prevent failure or to provide opportunities for learning is to ensure that every student has an effective teacher every year. Lesley (2010) gave specific examples of how recruitment, retention, and distribution of teachers are critical in student achievement. Above all, effective teachers need to be placed in campuses with the highest need.

Another important resource allocation decision is ensuring that class sizes maintain a maximum student-teacher ratio of 22:1. The student-teacher ratio is the most expensive school funding item. One concern linked to larger class sizes is the increase in teacher turnover. Early childhood education is also a growing necessity. Students need the opportunity to get a head start, and prekindergarten provides this needed assistance. Research has indicated that prekindergarten programs increase school readiness; reduce the achievement gap; improve
academic performance; and reduce dropout rates, incarceration rates, and special education referrals (Lesley, 2010). Schools that have the resources to provide struggling learners with safety nets or interventions experience increases in academic performance.

One of the most popular resource allocation strategies is the availability of a rigorous curriculum, materials, and technology. The data show that Texas curriculum standards are not as rigorous as are those of other states, and Texas students typically score much higher on the Texas Assessment of Knowledge and Skills (TAKS) test than on the National Assessment of Educational Progress (NAEP) (Lesley, 2010). The rigor required for today’s curriculum requires more resources than ever before; of course, these resources cost money (Lesley, 2010).

Typically, school districts report spending two-thirds of their budgets on classroom instruction, regardless of student achievement. Additionally, administrators do not report significant patterns between resource allocation and student achievement (Alexander et al., 2000).

Resource Allocation and Student Achievement: National Concern and Solutions

The public perception is that the federal government inappropriately handles resource allocation for public education (Lips et al., 2008). Research on resource allocation emphasizes five areas of concern (1) United States spending on public education, (2) historical trends in public education, (3) education spending and academic achievement, (4) resource allocation, and (5) steps the federal government can take to alleviate the problem (Lips et al., 2008). One strategy that some states have implemented is the 65% Solution, which requires that each school district spend 65% of its budget on instructional activities including teacher salaries, materials, and curriculum (Helvey, 2006).

The government must deal with the notion that too many barriers and challenges exist in the current financial world. These barriers connect spending to student academic results and
require a system that supports student learning. Even though the 65% Solution is in place, districts continue to struggle with proving the exact amount spent on classroom instruction (Gazzerro & Laird, 2008). Pan and Rudo (2003) recommended that states investigate whether adequate funds are available for schools to support instructional goals, provide guidance to help districts build capacity among staff members and new hires, and provide local decision makers with resources to study the data and allocated funds to support low-performing districts.

Another viewpoint is the need for a school reform movement that focuses on resource allocation patterns of school districts. Miles (2000) suggested creating a reform movement based on resource allocation and student achievement that encourages schools to restructure resources. Research supports the notion that resources allocation usually means staff positions, not curriculum. Currently, schools staff one adult for every nine students; however, teachers continue to express the lack of resources to meet their students’ needs. Schools meet student achievement goals when they find ways to harness their resources and focus them on student achievement. Miles (2000) also suggested that resource allocation shift to individual campuses, which would allow administrators to hire and retain staff members that fit their campus’ needs. Campuses would also have the flexibility to use staff members where they are needed most to ensure increased time for academic instruction (Miles, 2000).

Several researchers have agreed that resource allocation concerns will continue unless policymakers get involved. As long as districts continue to spend money on flawed programs, these concerns will remain (Miles, 2000). Individual schools need more decision-making power on how money is spent on their campuses. By reassigning this responsibility to the campus level, schools would be able to develop strategies to organize time, staff, and money to improve student achievement. A popular trend in resource reallocation is organizing time to allow
teachers the opportunity to collaborate with each other, increase instructional time, train staff and
students to work in small groups, and increase personal attention. Small groups are created
based on students’ needs, and they are flexible and change throughout the day. Successful
schools also allocate resources into intervention, not remediation. In these schools, teachers take
on specific roles to support student achievement and staff includes fewer paraprofessionals and
more professional teachers. Finally, staff receives additional time and money for professional
development and technology that is integrated throughout the curriculum (Miles, 2000).

Two other possible policy implications regarding resource allocation concern (1)
expenditures as systematically related to student achievement and (2) policies that are not based
on school factors such as class size or teacher education because these factors do not influence
student achievement directly (Hanushek, 1989). This viewpoint has brought a dissenting opinion
from some researchers. For example, Gintis (1995) stated that Hanushek offered a lack of
appropriate evidence, but continued to make recommendations without providing an economic
reason for his suggestions.

The relationship between resource allocation and student achievement has been part of
the educational system since the original little red schoolhouses in the 1800s. Two-hundred
years later, this relationship remains a vital part of the educational system. The overall goal of
education remains the same; however, methods of funding education change constantly. The
research reviewed provides a great deal of information and theory on what needs to happen in
education for students to achieve at the highest levels possible while districts become more cost
efficient. Once again, the current expectation is that districts and students will do more with less.

In Texas, where money is getting tighter, researchers have argued in favor of increasing
funding. Funding must be in place to ensure that students have access to effective teachers,
curriculum that provides rigor, limited class sizes, interventions for struggling students, and
prekindergarten programs that allow students a head start in their educational careers. It is time
for policymakers to step up and support the educational system in Texas and nationwide.
Obtaining student achievement at the highest levels possible will not happen if the resources
needed are not provided. Researchers have often disagreed over whether resource allocation
significantly influences student achievement. Therefore, research must continue for school
districts to provide quality and efficient education to all students.

Intradistrict Resource Allocation Approach

Educational researchers have examined intradistrict expenditure patterns of individual
school districts. Such research has provided evidence on the expenditure practices across
schools within single districts to answer the question of whether all schools within a district
receive equal funding. Instead of analyzing wealth and spending, intradistrict analyses focus
directly on relationships between funding and student race, poverty level, and geographic
location.

One study of within-district resource allocation found significant disparities in resources
(Stiefel, Rubenstein, & Berne 1998). Ajwad (as cited in Baker, 2006) used Texas school-level
expenditure data to evaluate within district resource allocation among schools in high poverty
neighborhoods. Ajwad found that Texas school districts typically allocate additional resources
for elementary schools in higher poverty neighborhoods using neighborhood resident population
characteristics rather than school enrollment. Roza et al. (as cited in Baker, 2006) evaluated
changes in within-district resource allocation from 1994-2003 using Texas school-level
expenditure data. The research provided evidence that funding decisions within districts had a
greater influence on a school’s resources than did inequalities in access to revenue across school districts.

Summers and Wolfe (as cited in Houck, 2011) studied schools in Philadelphia with a focus on campus-level resource equity. They found that schools with higher enrollments of African American and low-socioeconomic status (SES) students were more likely to have less experienced principals, higher teacher vacancy rates, and teachers with lower exam scores and lower quality undergraduate educations than did schools with smaller enrollments of the same student demographics. Hertert (as cited in Houck, 2011) examined the distribution of educational funds across and within California districts and found that equality in resource allocation across the state was credited to a change in statewide school finance policies.

Rubenstein (as cited in Houck, 2011) analyzed spending patterns within the Chicago Public School system. He found that base funding per pupil, defined as the core amount allocated by the district, was distributed equitably across all schools. Owens and Maiden’s (as cited in Houck, 2011) examination of school spending in Florida included all schools within one district’s boundaries. Their research resulted in a substantial inequity across elementary schools with some evidence that Title I funds may have been used in place of regular instructional funds.

Iatarola and Stiefel (as cited in Houck, 2011) examined intradistrict equity among 840 elementary and middle schools in New York City. These researchers looked at five measures, operating funds per pupil, direct service funds per pupil, pupil-teacher ratio, teacher salary, and percentage of certified teachers. The researchers reported inequitable spending levels across all elementary and middle schools. Condron and Roscigno (2003) examined the unique intra-district spending among 89 Ohio elementary schools on and student achievement patterns. Their study found a correlation between local spending and student poverty level.
Resource Allocation at the District and Campus Levels in Texas: Cost Function Codes

Over the past 60 years, academic researchers have devoted their time to answering the question of whether education expenditures affect student achievement. However, research findings have provided little to no clarity on this topic. To understand the impact that resource allocation has on student achievement, researchers must concentrate on how districts and schools spend money.

Researching money spent on specific function codes can shed light on a cause and effect relationship between resource allocation and student achievement. For example, production-function codes 11 and 21 concern instruction and school leadership. One must understand exactly what items fall under specific codes and how they affect student achievement. Production-function code 11, instruction, involves much more than teachers’ salaries, it also includes the skills and abilities to influence student achievement positively. Thus, teachers are the most important factor to enhancing student learning.

Instruction and Student Achievement

If one could identify a method or “silver bullet” to create an effective teacher, every classroom worldwide would be equipped with effective teachers. However, extensive research continues to seek common aspects that characterize effective teachers (Hattie, 2009; Marzano, 2007; Marzano, Pickering, & Pollock, 2004; Stronge, 2007). Although research is prevalent in this field and an overwhelming number of articles, books, and other literature has been published (Hattie, 2009; Marzano, 2007; Marzano et al., 2004; Stronge, 2007), teaching has scarcely changed over the past 200 years (Tyack & Cuban, 1995). One explanation for such little change in teaching and learning methods is the “lack of summarizing and comparing all the diverse types of evidence” (Hattie, 2009, p. 3).
In an attempt to summarize and compare the substantial amount of research, this researcher reviewed four meta-analyses of over 55,000 studies. The majority of the research cited came from Hattie (2009), Marzano (2007), Marzano et al. (2004), and Stronge (2007). Stronge (2007) examined over 300 studies and identified 27 qualities of effective teachers. Marzano et al. (2004) identified nine practices of effective teachers after reviewing approximately 300 studies. Marzano (2007) identified 15 teaching practices based on studies and meta-analyses by Haycock (1998), Marzano (2003), and Nye, Konstantopoulos, and Hodges (2004). Most recently, Hattie (2009) synthesized over 800 meta-analyses that included over 50,000 studies relating to high levels of student achievement and found nine areas directly linked to teachers’ behaviors and 34 linked to teaching approaches.

The categories represented in these four meta-analyses were narrowed to 15 practices of effective teachers. All categories relate to curricula, academia, and collegial interactions in the art of teaching and learning. While these categories are discussed as separate entities, in reality, they are intertwined; no one strategy can be isolated from the rest when developing an effective teacher (Hattie, 2009). The 15 practices include the following:

- Teacher preparedness: Planning and preparing for instruction and learning
- Behavior management: A safe and orderly learning environment
- Instructional strategies: Using differing types of pedagogy
- Adapting instruction: Using varying strategies to accommodate individual and group differences in the learning environment
- Expectations: Setting high standards for students and accepting the responsibility to ensure that students learn
• Complexity: Understanding the subject matter and its relationship to the intricate student learner
• Questioning: Monitoring the learning process
• Student engagement: Time-on-task
• Providing meaningful feedback: Clear, specific, and timely
• Building relationships: Creating trust between students and teachers
• Assessment: Gathering evidence, analyzing data, and using results to meet students’ individual needs
• Professional development: Life-long learning for all
• Teacher leadership: Personnel resources for academic growth
• Collaboration: Establishing principles to unite the school in pursuit of a shared purpose, common goals, and clear direction
• Personality: Individuals traits that enable teachers to relate to students and other members of the learning community

School Leadership and Student Achievement

Students who attend effective schools have a 44% difference in the expectation that they will pass a test with a typical passing rate of 50%. If students from effective and ineffective schools take the same test, 72% of those from effective schools would pass and only 28% of those from ineffective schools would pass, leaving a 44% difference (Marzano, Waters, & McNulty, 2005). According to Marzano et al. (2005), “If we consider the traditions and beliefs surrounding leadership, we can easily make a case that leadership is vital to the effectiveness of a school” (p. 4). Politicians, business leaders, parents, and community members demand higher quality education and place the responsibility of success on the shoulders of school principals.
Therefore, school principals must acquire and use various skill sets to be successful leaders and produce high achievement standards. Dantley (2005) stated, “Current school leaders are called to facilitate spaces where cultural differences are not only celebrated but concomitantly deconstructed through a process of critical self-reflection and an on-going discourse on issues of power and privilege” (p. 44).

Principals are essential to school functioning. After all, schools are not just for the children and teachers; they are also for the parents, community, state, and nation (Sergiovanni, 2007). Kochan and Reed (2005) noted, “The pace and intensity of the changes required of schools has increased and will likely continue to increase in the future” (p. 68). The increasing complexity of this system today, and in the future, demonstrates the vital nature of the job (Brown, 2005).

Resource Allocation Efficiency Models

School funding has been a concern for taxpayers and government officials for many years, and only recently have researchers engaged in advanced study to help alleviate funding concerns. Researchers have used several efficiency models to determine how school districts can better spend their money. The most common efficiency models used in the educational setting are the data envelopment analysis (DEA) and the frontier production function (FPF) (Fang & Zhang, 2008).

The DEA is an established technique among those in operations research. Between the inception of the DEA in 1978 by Charnes, Cooper, and Rhodes and 1992, over 470 articles have been published on the topic (Seiford, 1996), and the pace of research appears to have accelerated since that time (Kumar, 1997). With the DEA technique, the production efficiency of an
economic unit is measured by the amount that output can be increased to improve efficiency, given the input usage of the economic unit being evaluated (Kalirajan & Shand, 1999). The DEA calculates the economic efficiency of a specific campus relative to the performance of other campuses, assuming that they provide the same service rather than assuming an idealized standard of performance (Worthington, 2001).

Several researchers, including Coelli (1995), presented reviews of the techniques used with the DEA. Fang and Zhang (2008) also presented several advantages of the DEA approach. Of importance is that this approach avoids parametric specification of technology and has a distributional assumption for the inefficiency term. Another known advantage of this model is that it places no restrictions on the functional form of the production relationships between inputs and outputs.

Disadvantages of this method are that it is sensitive to variable selection and data errors (Kalirajan & Shand, 1999) and it produces inconsistent results. The DEA measures small samples, thus, is sensitive to the difference between the number of firms and the sum of inputs and outputs (Seiford, 1996). Therefore, this sensitivity may cause organizations to appear efficient when they are not (Kalirajan & Shand, 1999).

Bessent, Bessent, Kennington, and Reagan (1982) studied 167 Houston elementary schools and concluded that the DEA model had problems in obtaining data on inputs and outputs and in communicating results. Sengupta and Sfeir (1988) studied 25 California school districts and provided multiple situations where input-output combinations concentrated on means with non-normal error distributions. Lovell, Walters, and Wood (1993) studied 1,032 U.S. high schools and found that schools performed at higher levels concerning intermediate and long-term objectives. Duncombe, Miner, and Ruggiero (1997) examined operating expenditures per pupil,
test scores, and teachers’ salaries of 585 New York school districts and determined that the DEA model struggled to treat environmental factors adequately. Table 2 provides additional information regarding examples of studies that have used the DEA model in educational institutions.

Another commonly used efficiency model is the production frontier approach (PFA), developed by Aigner, Lovell, and Schmidt (1977). The PFA can be deterministic or stochastic (SFA). The deterministic approach is derived such that all deviations are assumed to result from inefficiency, which means that no allowance is made for noise or measurement error. The stochastic approach removes some limitations of the deterministic approach (Worthington, 2001). The premise behind the stochastic model is that the error term is composed of two parts, (1) the systematic component, which captures the effect of measurement error, other statistical noise, and random shocks, and (2) the one-sided component, which captures the effects of inefficiency (Chakraborty, 2009).

Numerous researchers have conducted studies using the stochastic and deterministic frontier models. For example, Deller and Rudnicki (1993) used the stochastic method in a study of 139 schools in Maine. They concluded that nondiscretionary inputs were an important determinant of efficiency outcomes. Bates (1997) examined 96 United Kingdom local education authorities and found that measurements of efficiency varied across methods. Worthington (2001) also showed a high correlation between relative efficiency measures.
Table 2

*Frontier Efficiency Applications in Education*

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Method</th>
<th>Sample</th>
<th>Inputs, outputs, explanatory variables</th>
<th>Analytical technique</th>
<th>Main findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bessent et al.</td>
<td>DEA</td>
<td>167 Houston elementary schools: 1978</td>
<td>Test scores from previous, percentage nonminority, students at full lunch price, attendance, number of professional staff per 100 pupils, local state and federal expenditures per pupil, number of special programs operated, percent of teachers with masters degrees and 3+ years experience, and number of full-time equivalent teaching days.</td>
<td>Descriptive analysis, tables of input/output slacks, diagrammatic analysis.</td>
<td>Major problems in DEA include obtaining data on inputs and outputs, and communicating results.</td>
</tr>
<tr>
<td>Deller &amp; Rudnicki</td>
<td>SFA</td>
<td>139 Maine schools: 1988-1989</td>
<td>Family influence (percentage of parents with college education and per-capita family income); peer influence (unemployment rate); per pupil instructional, administrative, operational, and busing expenditures; and cumulative average test scores.</td>
<td>ANOVA, Wilcoxon, Van der Waerden &amp; Savage tests across school admin type &amp; size</td>
<td>Nondiscretionary inputs an important determinant of efficiency outcomes.</td>
</tr>
<tr>
<td>Lovell et al.</td>
<td>DEA</td>
<td>1032 U.S. high schools: 1979-1980.</td>
<td>(i) Total staff, number of library volumes, physical facilities index; average number of mathematics, science, vocational education and foreign language classes taken; extracurricular activity index times enrollment, school course offering index, total hours of instruction received per student time enrollment; standardized follow-up test score, ratio of base year and follow-up tests score; average GPA, teacher assessment of percentage of pupils likely to attend college; and average postsecondary grades, postsecondary income, and highest educational level attained.</td>
<td>Descriptive analysis and second-stage ordinary least-squares regression.</td>
<td>Schools perform better at intermediate and long-term objectives than short-term objectives. Small proportion of variation explained by second stage regression.</td>
</tr>
<tr>
<td>Duncombe et al.</td>
<td>DEA</td>
<td>585 New York State school districts: 1990-1991</td>
<td>Operating expenditures per pupil; average test scores in reading, mathematics, and social studies; drop-out rate; environmental and teacher salary index; total enrollment; percentage of households with school-aged children, children in poverty, adults with college education, single parent, children at risk, and LEP.</td>
<td>Second stage Tobit regression, descriptive analysis.</td>
<td>Failure of standard DEA models to treat nondiscretionary environmental factors adequately.</td>
</tr>
</tbody>
</table>

However, measuring the efficiency with which a school district allocates resources is not an easy task. Hanushek (1996) supported the complexity of this task when he stated, “A concept which has a very clear meaning in textbook analyses of theory of the firm, but that becomes very cloudy in the world of public education” (p. 264). Researchers have recognized that any measure of inefficiency that fails to account for inputs and outputs is likely be inaccurate and unreliable (Chakraborty, 2009). Therefore, the purpose of this dissertation was to provide insight into using an appropriate PFA model to allocate resources efficiently without experiencing a negative effect on student achievement.

In 2011, the Education Data Collaborative (EDC) performed a pilot study with the El Paso Independent School District (ISD) that focused on its level of efficiency. This study is an example of the successful implementation of the DEA model in educational institutions. The purpose of the project was three-fold:

• To provide students, parents, teachers, principals, and administrators near real-time data regarding student growth and progress throughout the school year
• To provide principals near real-time data to monitor and ensure that the measure of teacher effectiveness was linked to student performance using a fair and transparent method
• To show areas of efficiency and effectiveness at the campus- and district-levels

The EDC used multiple regression analysis based on Daggett’s (2009) efficient and effective framework to make comparisons between each middle school. The variables used to analyze and determine potential savings included TAKS scores, instruction, instructional resources, school leadership, counseling, plant maintenance, and operations. District administration identified these variables as the most important even though the researchers examined additional variables.
Potential improvement was the percent of reduction between actual and target values. For example, school leadership had a potential reduction of 17.47% to reach the target goal of $380.80 per pupil. If the campus reached this goal, it would realize a potential savings of $71,187.46 for this variable alone (Byrd et al., 2011).

Campuses in the upper right-hand quadrant of Daggett’s framework performed at the highest levels of efficiency and effectiveness, while campuses in the lower left-hand quadrant performed at the lowest levels of efficiency and effectiveness. The findings of the El Paso ISD study suggest that school districts that were willing to make tough resource allocation decisions could potentially save money while continuing to educate students at the same or higher levels. These results also provided information regarding the percent of reduction in five key areas that are necessary for each campus to be considered 100% efficient. In fact, the percent reduction, which can be viewed as a measure of inefficiency, could yield a savings of more than $11 million over a 2-year period (Byrd et al., 2011).

International Perspective

The need for financial efficiency in the educational settings is not limited to the United States. Several international studies have supported the fact that educational institutions worldwide struggle with being more efficient in their resource allocation. BenDavid-Hadar and Ziderman (2010) conducted a study based in Israel that focused on creating a new budget allocation formula to provide a more equitable distribution of educational achievement. The new concept, improvement in the educational achievement distribution (IEAD), addressed issues of horizontal and vertical equity, and offered schools incentives for educational gains. Specifically, the school systems studied allocated school resources according to a needs-based approach (BenDavid-Hadar & Ziderman, 2010). Using this new formula, school funding in Israel changed
its focus to emphasize adequate equal funding for schools based on student numbers rather than student needs (BenDavid-Hadar & Ziderman, 2010).

Zoghbi, Rocha, and Mattos (2013) studied the efficiency of higher education institutions in Brazil with the emphasis on determinants, relative efficiency of public and private institutions, and their application of resources. After determining the decision making units (DMU) of the study and using the SFA model, the researchers concluded that private institutions were more efficient compared to public institutions. The findings yielded the following four implications:

1. Labor input (professor per student) negatively affects the difference in standard assessments, which would be counterintuitive.
2. Capital input positively affects the difference in standard assessment scores.
3. A pedagogical plan negatively affects the difference in assessment scores.
4. Socioeconomic characteristics of students are important (Zoghbi et al., 2013).

Summary

Researchers such as Hanushek (1996), Hedges and Greenwald (1996), Greenwald, Hedges, and Laine (1996), and Odden, Picus, and Goetz (2010) have differing views on the influence of resource allocation on student achievement. The variance among findings provides more than enough support to recommend that additional research is needed in this area. School funding patterns and student achievement continue to be hot topics across the state of Texas and throughout the United States. As educational institutions struggle with the lack of financial resources, it is imperative that all stakeholders continue to find ways to effect change within the broken financial system (Daggett, 2009).

As the state of Texas and individual school district gain knowledge regarding resource allocation and develop efficiency models, such as the DEA, the issues surrounding the lack of
school funding will decrease. All stakeholders must remember that educating the nations’
children should be a respected partnership between key stakeholders, administrators, teachers,
parents, and community leaders. Thus, it is the responsibility of every member of the
community to be part of the process of equipping students with the knowledge and skills needed
to be productive and successful citizens (Daggett, 2009). However, the question remains, “Can
districts become more efficient in the distribution of resources while increasing student
achievement?”
CHAPTER 3

METHOD

This study explored the relationship between resource allocation and student achievement, with a focus on creating an efficiency model. The purpose of the model was to allow districts to become more efficient in resource allocation without affecting student achievement negatively. Specifically, this study targeted 22 elementary campuses and six middle schools in a selected school district in Texas. A significant amount of the previous research focused on the influence of financial resources on student achievement. This study focused on using an efficiency model to reveal how a district can operate effectively and efficiently while students continue to achieve at high levels.

Research Design

The research design was based on the theoretical framework of Daggett (2009). Daggett’s work on efficiency and effectiveness was released soon after the nation fell into a fiscal crisis and the American Recovery and Reinvestment Act (ARRA) stimulus package for education was implemented (Byrd et al., 2011). The foundation of Daggett’s effectiveness and efficiency framework is based on two challenges (see Figure 1):

1. Improve student performance.
2. Overcome the reduction of financial resources for education.

The vertical line in Figure 1 denotes the cost of initiatives, or efficiency, and the horizontal line represents student performance, or effectiveness, of initiatives. In the framework, Quadrant A represents low efficiency and low effectiveness, Quadrant B represents high efficiency and low effectiveness, Quadrant C represents low efficiency and high effectiveness,
and Quadrant D represents high efficiency and high effectiveness. Leaders should consider those initiatives in Quadrant D and question those in Quadrant A (Daggett, 2009).

**Effectiveness and Efficiency Framework**

![Effectiveness and Efficiency Framework](image)

*Figure 1. Efficient and effective framework. (Daggett, 2009).*

With the challenge facing schools and districts is to do more with fewer resources, this study sought to understand where efficiency could be created at the elementary and middle school levels, clarify the link between student performance and resources, and seek potential areas of savings for schools and districts (Byrd et al., 2011). The goal of this study was not to fix elementary and middle school education; rather, to provide an alternative to the current model of policy-driven practice and determine whether practice could drive policy.

The data envelopment analysis (DEA) allows school districts to determine the efficiency of campus operations using the efficiency framework. Specifically, the DEA offers the following four benefits:
• Compares each campus’s DMU or resources allocated per production-function code and identifies the most efficient and inefficient units.

• Calculates the amount and type of cost and possible resource savings that can be achieved by making each inefficient unit as efficient as the most efficient unit or production-function code.

• Estimates the amount of additional services an inefficient unit can provide without using additional resources.

• Provides school administration with information about the performance of each unit that may be used to help transfer the focus from relatively efficient units to inefficient units, which allows inefficient units to become more efficient and leads to higher efficiency for the institution (Sherman & Zhu, 2006).

Participants

I obtained data from the Texas Education Agency (TEA), which included elementary and middle school campus-level financial and student performance data. Data were collected from 28 campuses (22 elementary and six middle schools) that had complete data for 3 consecutive years from 2009-2011.

The district that provided data for this study had an enrollment of approximately 26,000 students with a total elementary and middle school student enrollment for each year studied of 15,529 students. Demographic data collected from participating schools included White (18%), non-White (82%), economically disadvantaged (62.3%), and at-risk (45%) students. Each campus’s enrollment numbers were used to determine the level of efficiency.
Student Enrollment

The study yielded specific data regarding student enrollment on elementary- and middle-school campuses. Table 3 provides data regarding the student enrollment for all 22 elementary campuses within the selected district. The smallest campus served 338 students, and the largest campus served 721 students. On average, each elementary school had an enrollment of 493 students with a standard deviation of 99.701. Campuses within the district varied greatly in the percentage of students who were non-White (52.7% to 99%), economically disadvantaged (20.5% to 91.4%), at-risk students (16.9% to 78.8%), and LEP students (9.7% to 71%).

Table 3

Descriptive Statistics Average Elementary Enrollment Data for 2009-2011

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total enrollment</td>
<td>22</td>
<td>493.50</td>
<td>99.70</td>
<td>338</td>
<td>721</td>
</tr>
<tr>
<td>White</td>
<td>22</td>
<td>20.40</td>
<td>13.92</td>
<td>1.00</td>
<td>47.30</td>
</tr>
<tr>
<td>Non-white</td>
<td>22</td>
<td>79.68</td>
<td>13.96</td>
<td>52.70</td>
<td>99.00</td>
</tr>
<tr>
<td>Economically disadvantaged</td>
<td>22</td>
<td>58.11</td>
<td>22.88</td>
<td>20.50</td>
<td>91.40</td>
</tr>
<tr>
<td>At-risk</td>
<td>22</td>
<td>46.70</td>
<td>18.04</td>
<td>16.90</td>
<td>78.80</td>
</tr>
<tr>
<td>LEP</td>
<td>22</td>
<td>34.33</td>
<td>18.16</td>
<td>9.70</td>
<td>71.00</td>
</tr>
<tr>
<td>Valid N</td>
<td></td>
<td></td>
<td></td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

N = Number of elementary campuses in district.

Table 4 provides data regarding the student enrollment for all six middle school campuses within the selected district. The smallest campus served 776 students, and the largest campus served 1,042 students. On average, each middle school had an enrollment of 906 students with a standard deviation of 105.69. The campuses within the district varied greatly in
the percentage of students who were non-White (65.7% to 90.6%), economically disadvantaged (41.2% to 80.7%), at-risk students (29.1% to 52.2%), and LEP students (5.5% to 16.4%).

Table 4

### Average Middle School Enrollment Data 2009-2011

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total enrollment</td>
<td>6</td>
<td>906.50</td>
<td>105.69</td>
<td>766.00</td>
<td>1042.00</td>
</tr>
<tr>
<td>White</td>
<td>6</td>
<td>19.38</td>
<td>8.81</td>
<td>9.40</td>
<td>34.30</td>
</tr>
<tr>
<td>Non-White</td>
<td>6</td>
<td>80.61</td>
<td>8.81</td>
<td>65.70</td>
<td>90.60</td>
</tr>
<tr>
<td>Economically disadvantaged</td>
<td>6</td>
<td>62.76</td>
<td>16.38</td>
<td>41.20</td>
<td>80.70</td>
</tr>
<tr>
<td>At-risk</td>
<td>6</td>
<td>40.61</td>
<td>9.85</td>
<td>29.10</td>
<td>52.20</td>
</tr>
<tr>
<td>LEP</td>
<td>6</td>
<td>10.15</td>
<td>4.45</td>
<td>5.50</td>
<td>16.40</td>
</tr>
</tbody>
</table>

N = Number of middle school campuses in district.

Comparing the descriptive statistics included in Tables 3 and 4 provides valuable information on the significant changes that take place regarding student enrollment at the elementary and middle school levels. The average student enrollment at the 22 elementary campuses was 493 compared to 906 students at the six middle school campuses. The average number of non-White students at the elementary and middle school levels were similar, 79.6% in elementary and 80.1% in middle school. A slight discrepancy emerged in the average number of economically disadvantaged students with 58.1% at the elementary level and 62.7% at the middle school level. Additionally, 46.7% of students were identified as at-risk at the elementary level and 40.6% at the middle school level. The largest variance occurred among students identified as LEP. The elementary school average was 34.3% compared to 10.1% at the middle school level.
The results provided in Table 5 show the descriptive statistics for the average student enrollment in the selected Texas school district. The smallest campus served 338 students, and the largest campus served 1,120 students. On average, each campus had an enrollment of 588 students with a standard deviation of 216.80. The campuses varied greatly in the percentage of students who were economically disadvantaged, which ranged from 20.5% to 91.4%; students identified as at-risk ranged from 16.9% to 78.8%; and students identified as LEP ranged from 5.5% to 71%. These statistics provide valuable data regarding the diversity of the individual campuses.

Table 5

Descriptive Statistics District Average Student Enrollment Data 2009-2011

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total enrollment</td>
<td>28</td>
<td>588.46</td>
<td>216.80</td>
<td>338</td>
<td>1120</td>
</tr>
<tr>
<td>White</td>
<td>28</td>
<td>20.86</td>
<td>13.13</td>
<td>1.00</td>
<td>47.30</td>
</tr>
<tr>
<td>Economically disadvantaged</td>
<td>28</td>
<td>58.11</td>
<td>21.70</td>
<td>20.50</td>
<td>91.40</td>
</tr>
<tr>
<td>At-risk</td>
<td>28</td>
<td>44.89</td>
<td>16.94</td>
<td>16.90</td>
<td>78.80</td>
</tr>
<tr>
<td>LEP</td>
<td>28</td>
<td>29.15</td>
<td>19.04</td>
<td>5.50</td>
<td>71.00</td>
</tr>
<tr>
<td>Valid N</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N = Total number of elementary and middle school campuses in district

Variables Examined

Dependent Variables

The current study was conducted at the district-, campus-, and student-levels. The dependent variable was the scale score on third-, fifth-, and eighth-grade reading and mathematics Texas Assessment of Knowledge and Skills (TAKS) from the 2009, 2010, and 2011
The TAKS is a comprehensive criterion-reference assessment based on the state standardized curriculum, the Texas Essential Knowledge and Skills (TEKS).

Independent Variables

The independent variables included several variations in which I analyzed campus expenditures. I chose these variables because they included expenditures that most closely aligned with direct instructional spending. The independent variables included the following:

- Total campus money expended in TEA production-function codes 11, 12, 21, 23, and 31 (see details below).
- Percentage of students from low SES (qualified for free and reduced lunch program).
- Total number of at-risk students (students who meet the state criteria).
- Total student enrollment (total number of students enrolled in selected campuses).

The final reported expenditures of campus-level financial data were requested from the Public Education Information Management System (PEIMS) for several budgetary functions in financial accounting standards. These standard categories were used to report expenditures in the TEA financial management system. I made campus-level financial requests to the state funding division of the TEA for the following production-function codes:

- Code 11: Instruction. This code refers to expenditures for instructing students (e.g., teacher salary).
- Code 12: Instructional-Related Services. This code refers to expenditures used to establish and maintain libraries and media services.
- Code 21: Instructional Leadership. This code refers to expenditures tied to managing, directing, and supervising instructional programs (e.g., salaries for instructional coaches and facilitators).
- Code 23: School Leadership. This code refers to expenditures included within campus administration (e.g., principal and assistant principal salaries).
- Code 31: Student Support Services. This code refers to expenditures included in operating the campus guidance and counseling services.

I made a second financial request for total dollars spent per student during the 2009, 2010, and 2011 academic years.

Production-Function Code Expenditures

Table 6 shows the descriptive statistics for all 28 elementary and middle school campuses regarding the expenditures the district allocated per pupil for production-function codes 11, 12, 21, 23, and 31. The numbers represent the total dollars spent per pupil on each code. The amount of money spent on classroom instruction ranged from $3,803 to $5,252, depending on the campus. Figures for campus administration almost doubled from the lowest of $374 to the highest of $614. Instructional leadership cost one campus $35 per pupil and four times that amount ($117) at a different campus.

Table 6

*District Function Code Descriptive Statistics (Per-Pupil) 2009-2011*

<table>
<thead>
<tr>
<th>Code</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction</td>
<td>28</td>
<td>4,490.07</td>
<td>374.34</td>
<td>3,803</td>
<td>5,252</td>
</tr>
<tr>
<td>Instructional-Related Services</td>
<td>28</td>
<td>299.68</td>
<td>93.11</td>
<td>208</td>
<td>669</td>
</tr>
<tr>
<td>Instructional Leadership</td>
<td>28</td>
<td>63.75</td>
<td>25.24</td>
<td>35</td>
<td>117</td>
</tr>
<tr>
<td>School Leadership</td>
<td>28</td>
<td>468.89</td>
<td>66.23</td>
<td>374</td>
<td>614</td>
</tr>
<tr>
<td>Student Services-Support</td>
<td>28</td>
<td>394.11</td>
<td>72.99</td>
<td>247</td>
<td>540</td>
</tr>
<tr>
<td>Valid N</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(N = \text{Number of campuses in district}\)
In the selected Texas school district, the minimum amount spent on a campus for instruction was $3,803 and the maximum was $5,252 with a mean of $4,480 and a standard deviation of $370.85. Instructional-related services ranged from $208 to $298 per pupil. Instructional leadership, which included instructional coaches and facilitators ranged from $35 to $117. The number of coaches and facilitators varied per campus. School administration ranged from $374 to $614 per pupil throughout the district. Student services and counseling support expenditures ranged from $247 to $540. District expenditures had wide range in the amount spent per pupil.

Tables 7 and 8 detail the variance between elementary and middle school campuses. The elementary campus expenditure data showed a wide range between the minimum and maximum spent on each production-function code. The highest amount spent on an elementary campus for instruction per pupil was $5,252 and the lowest was $3803. The cost for instructional leadership also had a wide range between a minimum of $35 to a maximum of $117. The number of instructional coaches and facilitators assigned to each campus affected this expenditure rate. Campus administration at the elementary ranged from $374 to $614 based on the number of years of service one had as an administrator. Student services and counseling ranged from $247 to $540.

Table 8 shows that middle school expenditures did not have the same range as did elementary schools. Instructional expenditures per pupil at the middle school ranged from $3,711 to $4,701. In comparison, elementary campuses spent more money, on average, on instruction $4,515 compared to the middle schools with an average of $4,238. Elementary campuses also spent more on instructional-related services ($314 per pupil) compared to middle school campuses ($284 per pupil). Instructional leadership costs at the elementary level ($35)
were lower than that at the middle school level ($99). Campus administration also differed in elementary administrative costs, which averaged $471.59 compared to those at middle schools, which averaged $488. Support services and counseling costs at elementary campuses were significantly lower ($388) than those costs at middle school campuses ($403.17) per pupil.

Table 7

*Elementary Production-Function Code Descriptive Statistics (Per Pupil)*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction</td>
<td>22</td>
<td>4,515.18</td>
<td>388.37</td>
<td>3803</td>
<td>5252</td>
</tr>
<tr>
<td>Instructional-Related Services</td>
<td>22</td>
<td>314.59</td>
<td>99.12</td>
<td>228</td>
<td>669</td>
</tr>
<tr>
<td>Instructional Leadership</td>
<td>22</td>
<td>54.00</td>
<td>18.01</td>
<td>35</td>
<td>117</td>
</tr>
<tr>
<td>School Leadership</td>
<td>22</td>
<td>471.59</td>
<td>71.36</td>
<td>374</td>
<td>614</td>
</tr>
<tr>
<td>Student Services-Support</td>
<td>22</td>
<td>388.91</td>
<td>78.52</td>
<td>247</td>
<td>540</td>
</tr>
</tbody>
</table>

Valid N: 22

N = number of elementary campuses in district

Table 8

*Descriptive Statistics Middle School Production-Function Codes 2009-2011*

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruction</td>
<td>6</td>
<td>4,238.00</td>
<td>405.91</td>
<td>3711</td>
<td>4701</td>
</tr>
<tr>
<td>Instructional-Related Services</td>
<td>6</td>
<td>284.83</td>
<td>50.51</td>
<td>241</td>
<td>377</td>
</tr>
<tr>
<td>Instructional Leadership</td>
<td>6</td>
<td>99.17</td>
<td>11.58</td>
<td>80</td>
<td>110</td>
</tr>
<tr>
<td>School Leadership</td>
<td>6</td>
<td>488.83</td>
<td>42.10</td>
<td>430</td>
<td>545</td>
</tr>
<tr>
<td>Student Services-Support</td>
<td>6</td>
<td>403.17</td>
<td>61.63</td>
<td>340</td>
<td>509</td>
</tr>
</tbody>
</table>

Valid N (listwise): 6

N = Number of middle school campuses in district
Procedure

I downloaded the majority of the data for this study from the Academic Excellence Indicator System (AEIS) on the TEA website for the 2009, 2010, and 2011 academic years. The PEIMS includes all data requested and received by the TEA about public education, including student demographics and academic performance, personnel, financial records, and organizational information (Carter, 2012; TEA, 2009; 2010b; 2011). The district used in this study submitted the data found in the AEIS reports. The following fields were used to construct the data for the study: campus number, total enrollment count, total number of non-Anglo students on each campus, total number of economically disadvantaged students per campus, total number of at-risk students per campus, campus percent passing TAKS reading, and campus percent passing TAKS math. Campus financial information regarding dollars allocated for production-function codes 11, 12, 21, 23, and 31 were also provided in the AEIS reports.

Data Analysis

The DEA is a linear programming technique used to measure the relative performance of organizational units where the presence of multiple inputs and outputs makes comparisons difficult (Emrouznejad, 2011). I used linear regression as the statistical method to test for possible correlations between the dependent variables (campus passing percent on the TAKS reading and math) and the independent variables (production-function codes 11, 12, 21, 23, and 31). The DEA was used to perform the regression calculations.

I conducted two analyses to test the null hypotheses. Analysis 1 compared the TAKS reading scores (dependent variable) to the selected production-function codes (independent variables). The same predictor variables were used for Analysis 2, which compared TAKS math scores to the independent variables. I applied an input-output-oriented model where efficiency
was calculated to determine the highest output that could be produced using the least amount of input. The typical mathematical representation used to measure efficiency was as follows:

\[
\text{Efficiency} = \frac{\text{Output}}{\text{Input}}
\]

Of note, this equation is usually not adequate because of the multiple inputs and outputs related to the various resources used in educational settings. To analyze resource allocation practices of an educational institution, the inputs were the amounts of money spent on production-function codes 11, 12, 21, 23, and 31, and the outputs were the level of student achievement attained on the TAKS.

This study examined production-function codes of 22 elementary campuses and level of student achievement to determine whether individual campuses were running as efficiently as possible. Each campus provided different inputs and outputs, which made efficiency comparisons difficult. Additionally, the measurement of relative efficiency involves multiple inputs and outputs (Farrell, 1957) and focuses on the construction of a hypothetical efficient unit as a weighted average of efficient units to act as a comparator for an inefficient unit (Emrouznejad, 2011). A common measure for relative efficiency is as follows:

\[
\text{Efficiency} = \frac{\text{Weighted Sum of Outp}uts}{\text{Weighted Sum of Inputs}}
\]

This equation can also be written as follows:

\[
\text{Efficiency} = \frac{u_1 y_{1j} + u_2 y_{2j} + \ldots}{v_1 x_{1j} + v_2 x_{2j} + \ldots}
\]

where

- \(u_1\) = the weight given to output i
- \(y_{1j}\) = amount of output 1 from unit j
- \(v_1\) = weight given to input 1
- \(x_{1j}\) = amount of input 1 to unit j
This formula assumes that the measure of efficiency requires a common set of weights applied to all units, which creates the problem of determining a common set of weights. These two concerns presented difficulty in obtaining a common set of weights. First, it is not easy to place a value on inputs or outputs. Second, not all institutions allocate their resources in the same way; therefore, the relative values of the inputs may be different (Emrouznejad, 2011).

Summary

This study determined educational efficiency of 22 elementary campuses and six middle school campuses in a selected school district in Texas using DEA and regression analysis. I considered variables commonly examined and factors unique to Texas education in the methods and analyses. The dependent variables were the 2009, 2010, and 2011 TAKS reading and mathematics results, and the independent variables were district-level instructional allocations percentages for the 2009, 2010, and 2011 academic years for production-function codes 11, 12, 21, 23, and 31.

I selected the TAKS reading and mathematics as the dependent variables because they represented test results from the majority of the student population, and their high-stakes role in the Texas accountability system made them valid predictors of student achievement. I selected the production-function codes as the independent variables because they best represented the categories that districts allocate money for direct instruction. Additionally, I used a multiple linear aggression approach to address the research questions, and the statistical software applications, DEA and SFA, to compute the correlations and statistical significance of the two separate analyses. Results of these analyses and their application to the research questions are reported in Chapter 4 followed by the conclusion in Chapter 5. This study provides a model for all educational leaders to use in creating efficient districts.
CHAPTER 4
ANALYSIS

Previous studies have compared schools and districts across the state; however, using other districts as comparisons may not be the best method to design school improvement plans as each has unique characteristics that may be hinder valid comparisons (Byrd et al., 2011). These characteristics may include variance within student demographics, culture, and values that inhibit a fair comparison. The current study examined the financial efficiency and student achievement of each elementary and middle school campus in one Texas school district.

The comparison of individual campuses had the following advantages: (1) using like campuses allowed for easier comparisons, (2) goals and objectives were shared across the entire district, (3) expenditures per campus used the same formula, and (4) student demographics and cultures were similar within the district. The approach taken within the study provided an estimated potential savings of $10 million over a 3-year period for elementary campuses and $4 million for middle school campuses. Findings are presented in graphical and table format.

Campus Efficiency and Financial Impact

Table 9 displays an efficiency report that includes the average expenditures spent per student for each identified production-function code within the Texas school district studied over a 3-year period (2009-2011). The report is divided into four columns and provides specific information on how much money was spent, should be spent, and the potential savings that exists based on the level of effectiveness regarding students’ abilities to meet the standard score on the Texas Assessment of Knowledge and Skills (TAKS).

The first column lists the variables used in this study to determine the efficiency of elementary and middle schools. Function 11 refers to expenditures allocated for classroom
instruction. Function 12 refers to instructional resources (e.g., libraries and media services). Function 21 refers to expenditures used for instructional leadership. Function 23 refers to campus administration costs. Function 31 refers to costs for providing counseling services and assessing and testing students’ abilities. The second column is dollars spent, which represents the actual dollars spent for each campus to function. The third column is target, which represents the amount of dollars the campus should spend per pupil to obtain efficiency. The last column, potential savings, is the estimated savings a campus could achieve under each function code.

Table 9

Efficiency Report over a 3-year Period, 2009-2011

<table>
<thead>
<tr>
<th>All Campuses (N = 28)</th>
<th>Dollars Spent</th>
<th>Target</th>
<th>Potential Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAKS</td>
<td>78</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>Code 11: Instruction</td>
<td>$4602.75</td>
<td>$4279.67</td>
<td>$10,352,309.42</td>
</tr>
<tr>
<td>Code 12: Instructional-Related Services</td>
<td>$315.51</td>
<td>$293.14</td>
<td>$723,059.75</td>
</tr>
<tr>
<td>Code 21: Instructional Leadership</td>
<td>$72.02</td>
<td>$61.12</td>
<td>$350,349.56</td>
</tr>
<tr>
<td>Code 23: School Leadership</td>
<td>$490.22</td>
<td>$457.25</td>
<td>$1,297,636.23</td>
</tr>
<tr>
<td>Code 31: Student Support Services</td>
<td>$413.09</td>
<td>$368.57</td>
<td>$1,254,353.91</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$13,977,708.87</td>
</tr>
</tbody>
</table>

The financial results from all 28 campuses indicated that 13 campuses averaged 100% efficiency over the 3-years studied, and 15 campuses showed potential savings in one or more function code during 1 or more years studied. During the 3-year period studied, 78% of students met expectations on the TAKS. The function code with the greatest amount of potential savings over the 3 years was instruction (potential savings of over $10 million). The five campuses considered inefficient had a potential savings of $14 million over a 3-year period (see Based on Figure 4. The following sections report the results by campus type (elementary and middle).
Elementary Efficiency

Table 10 includes the longitudinal comparison of efficiency scores across a 3-year period among all elementary schools in the district. At the elementary level, efficiency scores varied significantly among Furneaux, McKamy, and McLaughlin Elementary Schools. The efficiency scores of these three elementary schools consistently fluctuated each year. In contrast, Riverchase Elementary was the most inefficient campus consistently during the 3-year period. Finally, 13 elementary campuses operated at a high efficiency level during each of the 3 years studied (Mean Efficiency = 100, SD = 0).

Middle School Efficiency

Table 11 provides the longitudinal comparison of efficiency scores across a 3-year period for all middle schools studied. At the middle school level, efficiency scores varied significantly among Bush, Field, and Long Middle Schools. The efficiency scores of these three middle schools varied each year with a range of approximately 10 percentage points. Only one middle school campus consistently operated at a high efficiency level each of the 3 years studied (Mean Efficiency = 100, SD = 0).

District Efficiency

Table 12 shows the 3-year average efficiency scores for all campuses. The Texas school district operated at an efficiency rate of .96, with the elementary campuses functioning at a slightly higher rate of .97 (SD = .049) compared to middle school campuses at .94 (SD = .044). The lowest minimum efficiency score in the district was at the elementary level (.86) compared to the lowest middle school efficiency score (.89).

Table 10

*Elementary Efficiency Scores over a 3-year Timeframe*
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Blanton</td>
<td>96.26</td>
<td>97.99</td>
<td>93.38</td>
<td>95.88</td>
<td>85</td>
</tr>
<tr>
<td>Carrollton</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>85</td>
</tr>
<tr>
<td>Central</td>
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<td>100</td>
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<td>100</td>
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<tr>
<td>Country Place</td>
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<td>Davis</td>
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<td>Freeman</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>89</td>
</tr>
<tr>
<td>Furneaux</td>
<td>80.24</td>
<td>92.50</td>
<td>97.5</td>
<td>90.08</td>
<td>81</td>
</tr>
<tr>
<td>Good</td>
<td>92.87</td>
<td>98.97</td>
<td>100</td>
<td>97.28</td>
<td>86</td>
</tr>
<tr>
<td>Kent</td>
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<td>100</td>
<td>100</td>
<td>100</td>
<td>97</td>
</tr>
<tr>
<td>La Villita</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>86</td>
</tr>
<tr>
<td>Landry</td>
<td>100</td>
<td>94.17</td>
<td>85.39</td>
<td>93.19</td>
<td>83</td>
</tr>
<tr>
<td>Las Colinas</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>93</td>
</tr>
<tr>
<td>McCoy</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>McKamy</td>
<td>86.22</td>
<td>77.45</td>
<td>96.49</td>
<td>86.72</td>
<td>86</td>
</tr>
<tr>
<td>McLaughlin</td>
<td>85.57</td>
<td>92.21</td>
<td>82.68</td>
<td>86.82</td>
<td>79</td>
</tr>
<tr>
<td>McWhorter</td>
<td>87.10</td>
<td>100</td>
<td>100</td>
<td>95.7</td>
<td>76</td>
</tr>
<tr>
<td>Rainwater</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>90</td>
</tr>
<tr>
<td>Riverchase</td>
<td>82.50</td>
<td>74.24</td>
<td>100</td>
<td>85.58</td>
<td>83</td>
</tr>
<tr>
<td>Rosemeade</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>96</td>
</tr>
<tr>
<td>Stark</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>Thompson</td>
<td>93.25</td>
<td>100</td>
<td>100</td>
<td>97.75</td>
<td>82</td>
</tr>
</tbody>
</table>

Over the 3-year period, the district functioned at an efficiency rate of .96 (see Table 13). The district showed a positive pattern of improvement in allocating resources and improving the efficiency score. In 2009, the district operated with an efficiency score of .95, showed a slight decrease in 2010, and a 1% increase in 2011 to .96. During each of the 3 years studied, some campuses functioned at the highest level (100%) while other functioned as low as .74.
Table 11

*Middle School Efficiency Scores over a 3-year Timeframe*

<table>
<thead>
<tr>
<th>Efficiency Score</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>Avg. Efficiency Score</th>
<th>Avg. Effectiveness Score on TAKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blalack</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>88</td>
</tr>
<tr>
<td>Bush</td>
<td>100</td>
<td>92.97</td>
<td>84.79</td>
<td>92.59</td>
<td>82</td>
</tr>
<tr>
<td>Field</td>
<td>98.27</td>
<td>83.88</td>
<td>85.21</td>
<td>89.12</td>
<td>73</td>
</tr>
<tr>
<td>Long</td>
<td>100</td>
<td>85.33</td>
<td>80.30</td>
<td>88.54</td>
<td>74</td>
</tr>
<tr>
<td>Perry</td>
<td>89.74</td>
<td>92.43</td>
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Table 12

*3-year Average Efficiency Scores for All Levels*

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*N* = Number of campuses at each level

The school district’s high efficiency rate is due to having 55% of the elementary campuses at a 3-year average of 100%, while only 16% of the middle schools received a 100% efficiency score over the same number of years. The lowest efficiency score at the elementary level was 86% compared the lowest middle school efficiency score of 89%.
Table 13

Pattern of District Efficiency Scores 2009-2011

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N = Number of campuses in district

Theoretical Framework with Results

This study used Daggett’s (2009) Effectiveness and Efficiency Framework to demonstrate how campuses compared to each other regarding efficiency scores and TAKS effectiveness. Daggett’s framework illustrates Quadrant A as low efficiency and low effectiveness, Quadrant B as high efficiency and low effectiveness, Quadrant C as low efficiency and high effectiveness, and Quadrant D as high efficiency and high effectiveness. Campuses with high efficiency and high student achievement appeared in Quadrant D of the framework, and campuses with low efficiency and low student achievement appeared in Quadrant A (see Figures 2-4). The x-axis represents campus efficiency. For the purposes of this study, campuses were considered efficient if their score was 90% or higher. Campuses on the right side of the vertical line were efficient. The y-axis provides information regarding student achievement on the state TAKS assessment. For the purposes of this study, campuses that obtained an average score of 85% or higher on TAKS were effective. These campuses are located above the
horizontal line. Following the Effective and Efficient Framework, efficient and effective campuses are located in Quadrant D.

All 22 elementary campuses appear in Figure 2. The information provided on the scatter plot shows that 19 of 22 elementary campuses yielded an efficiency score above of 90%. The scatter plot also shows that 13 of 22 elementary campuses shared the highest efficiency rating, and 14 campuses yielded an effective score above 85%. One campus fell within Quadrant C, which represents inefficiency and effectiveness. The results indicate that four campuses were efficient, but not effective; therefore, are located in Quadrant B. Two elementary campuses fell within Quadrant A, which is identified as inefficient and low effectiveness.

*Figure 2. Elementary school efficiency vs. TAKS (3-year average).*
All six middle school campuses appear in Figure 3. The information provided on the scatter plot shows that four middle school campuses yielded an efficiency score above 90%. The scatter plot shows that one campus, located in Quadrant D, had the highest efficiency rating, and five campuses yielded an effective score below 85%. The district did not have campuses in Quadrant C, which represents low efficiency and high effectiveness. The results indicate that three campuses were efficient but not effective. Two middle school campuses fell within Quadrant A (inefficient and low effectiveness).

Figure 3. Middle school efficiency vs. TAKS (3-year average).
Figure 4 provides information on the comparison of the efficiency and effectiveness scores for all 28 campuses using the same scale as previously mentioned. Again, 90% or higher on the x-axis was considered efficient and 85% or higher on the y-axis was considered effective. Of the 28 campuses, five were efficient and three were inefficient and ineffective (two middle schools and one elementary). Eight campuses were efficient but not effective on the TAKS. Finally, 50% of the campuses (13 elementary and one middle school) were efficient and effective.

![Figure 4. District 3-year average efficiency vs. TAKS.](image)

### Correlation Matrix

I conducted a Pearson product-moment correlation to assess the relationship between campus efficiency and student demographics and function code expenditures at the district level. The values of the Pearson correlation range from -1 to +1 with negative numbers representing negative correlations (as one variable increases, the other variable decreases) and positive
numbers representing positive correlations (as one variable increases, the other also increases). The analysis yielded a strong positive correlation between economically disadvantaged and at-risk students \((r = .773)\). As the number of at-risk students increased, the number of economically disadvantaged students also increased. A strong positive correlation also existed between economically disadvantaged students and LEP students \((r = .613)\) (see Table 14).

When observing the influence that each variable had on efficiency, it is easy to determine which variables need a reduction in the amount of funding designated for that function code. All five functions showed negative relationships with campus efficiency. Student demographic data had a negligible relationship with efficiency scores with a range of -.019 to +.019. School leadership showed a moderate negative relationship with efficiency \((r = -.315, p < .01)\), which suggests that school leadership explained approximately 10% of the variance in efficiency. The 95% confidence interval ranged from -.319 to -.310, meaning the correlation could be as high as -.319 or as low as -.310.

Instructional leadership showed a moderate negative relationship with efficiency \((r = -.361, p < .01)\), which suggests that instructional leadership explained approximately 13% of the variance in efficiency at the district level; the 95% CI ranged from -.365 to -.356. Student support services showed a strong negative relationship with efficiency \((r = -.472, p < .01)\), which suggests that student support services explained approximately 22% of the variance in efficiency at the district level. The 95% CI ranged from -.475 to -.466. If the district continues to spend a high dollar amount on these functions, campus efficiency scores will improve.
Table 14

Pearson Product-Moment Correlation between Function Codes, Student Enrollment, and Efficiency Overall District Results for 2009-2011

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**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Table 15 provides the results of the Pearson product-moment analysis, which assessed the relationship between campus efficiency and student demographics and function code expenditures at the elementary level. The results revealed a moderately strong correlation between instruction and instructional leadership \((r = .635)\), which suggests that the cost of instruction explained approximately 36% of the variance in instructional leadership. The analysis also revealed a strong negative correlation between total enrollment and White students \((r = -.695)\).

A strong positive relationship also existed between total enrollment and economically disadvantaged \((r = .523)\), at-risk \((r = .550)\), and LEP students \((r = .663)\). Campus efficiency at the elementary level showed a negligible relationship with three of five function codes (instruction, instructional-related services, and instructional leadership). School leadership and efficiency showed a weak negative relationship \((r = -.206, p < .01)\), which suggests that school leadership explained 4% of the variance in efficiency (95% CI ranged from -210 to -.201).

Student support services and efficiency had a strong negative relationship \((r = -.451, p < .01)\), which suggests that costs related to student support services explained 20% of the variance in efficiency at the elementary level. The 95% CI indicates that the correlation could be as high as -.455 and as low as -.446. As for student demographic data, the number of economically disadvantaged students at the elementary level and efficiency showed a weak negative relationship \((r = -.257)\); economically disadvantaged students explained approximately 7% of the variance in elementary campus efficiency. The 95% CI ranged from -.260 to -.251.
Table 15

*Pearson Product-Moment Correlation between Function Codes, Student Enrollment, and Efficiency Elementary Level 2009-2011*

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**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
The results of the Pearson product-moment analysis conducted to assess the relationship between campus efficiency, function code expenditures, and student demographics at the middle school level showed a greater negative effect on efficiency scores for the district at the middle school level. The analysis yielded very strong positive relationships for economically disadvantaged and at-risk students ($r = .880$), economically disadvantaged and LEP students ($r = .993$), and at-risk and LEP students ($r = .863$) (see Table 16).

A negligible relationship existed between instructional leadership and efficiency ($r = -.064$), which suggests instructional leadership influenced less than 1% of the variance in efficiency. Negligible relationships also existed between efficiency and the number of economically disadvantaged students ($r = -.053$) and the number of LEP students ($r = -.025$). This analysis revealed a very strong negative relationship between the costs of instruction per pupil and efficiency ($r = -.960, p < .01$), thus, instruction explained 92% of the variance in efficiency at the middle school level. The CI indicated that the correlation could be as high as -.965 or low as -.956. School leadership also yielded a very strong negative relationship with efficiency ($r = -.817$), which suggests that school leadership explained 67% of the variance in efficiency.

The only strong positive relationship was between efficiency and total enrollment at each middle school ($r = .676$). This finding suggested that the total enrollment at each campus explained 46% of the variance in efficiency scores. The 95% CI ranged from .680 to .671. Instructional-related services showed a strong negative relationship with efficiency ($r = -.711, p < .01$), which suggests that instructional-related services explained 50% of the variance in efficiency at the middle school level.
**Table 16**

*Pearson Product-Moment Correlation between Function Codes, Student Enrollment, and Efficiency Middle School Level 2009-2011*

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<td>-.519</td>
<td>.218</td>
<td>-.795</td>
<td>.993**</td>
<td>.863*</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>-.960**</td>
<td>-.711</td>
<td>-.064</td>
<td>-.817*</td>
<td>-.728</td>
<td>.676</td>
<td>.268</td>
<td>-.053</td>
<td>-.493</td>
<td>-.025</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*. Correlation is significant at the 0.05 level (2-tailed).
**: Correlation is significant at the 0.01 level (2-tailed).
Linear Regression

Table 17 provides the results of the linear regression performed to determine the effect of student demographic data and expenditures within each function code on efficiency at the district level. The total number of students per campus effected campus efficiency negatively ($\beta = -0.651$). The total enrollment of a district explained 42% of the variance in the efficiency score of the district. The number of at-risk students per campus ($\beta = -0.303$) explained 9% of the variance in the district efficiency score over the 3-year period. School leadership yielded a negative relationship with efficiency ($\beta = -0.221$), and explained 5% of the variance in the efficiency score. Instruction also yielded a negative relationship ($\beta = -0.530$), which indicated a 28% variance in the efficiency scores of the district. Student support services showed the strongest negative effect on efficiency ($\beta = -0.691$) and explained 48% variance in the efficiency score for the district.

Budgetary Plan Proposal

Based on the results of the Pearson product-moment and linear regression, a strategic budgetary plan should be created and implemented that focuses on predictors that have strong negative effects on campus and district efficiency scores. The current findings offer evidence that the cost of instruction per student and the cost of student support services play a large role in campus and district efficiency scores. By reducing the number of dollars spent in each of these functions, the district could save millions of dollars. Additionally, by examining individual campuses, decisions can be made regarding the programs offered to students, testing opportunities, counseling programs, and the possible movement of more experienced teachers, typically the highest paid, from campus to campus.
### Table 17

**Linear Regression on Student Enrollment Data and Function Code Expenditures for District 2009-2011**

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
</tr>
<tr>
<td>(Constant)</td>
<td>1.669</td>
<td>.310</td>
</tr>
<tr>
<td>Instruction</td>
<td>-8.430E-5</td>
<td>.000</td>
</tr>
<tr>
<td>Instructional-Related</td>
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<td>.000</td>
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<tr>
<td>Services</td>
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<td>Instructional Leadership</td>
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<td>.001</td>
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<tr>
<td>School Leadership</td>
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<td>.000</td>
</tr>
<tr>
<td>Student Services-Support</td>
<td>-.001</td>
<td>.000</td>
</tr>
<tr>
<td>Total Enrollment</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>White</td>
<td>.003</td>
<td>.002</td>
</tr>
<tr>
<td>Economically Disadvantaged</td>
<td>.001</td>
<td>.001</td>
</tr>
<tr>
<td>At-Risk</td>
<td>-.001</td>
<td>.002</td>
</tr>
<tr>
<td>LEP</td>
<td>.001</td>
<td>.001</td>
</tr>
</tbody>
</table>

a. Dependent Variable: Efficiency

**Summary**

The 2009, 2010, and 2011 data used to determine efficiency and effectiveness were obtained from the Academic Excellence Indicator System (AEIS) reports located on the Texas Education Agency (TEA) website. The current study revealed the relative efficiency scores compared to student achievement during a 3-year period (2009, 2010, and 2011) in a selected
Texas school district. The district selected included 28 elementary and middle school campuses that were compared to each other regarding their efficiency scores and TAKS results.

The data envelopment analysis (DEA) was used to calculate the efficiency scores for each elementary and middle school campus in the selected school district in Texas. Additionally, the Effectiveness and Efficiency Framework (Daggett, 2009) was used to express the results of efficiency and effectiveness of each campus within the selected Texas school district. The framework provided a descriptive display of campuses in the district that functioned at high levels of efficiency and effectiveness. This framework also served to identify campuses that functioned at inefficient and ineffective levels. Pearson product-moment and linear regression analyses identified areas of concern regarding resource allocation decisions that each campus may face. Multiple student demographic and function code variables helped determine the levels of efficiency and effectiveness. Chapter 5 provides conclusions and recommendations for future research.
CHAPTER 5

RESULTS

The purpose of this study was to determine the most efficient and effective practices a district can implement to create educational equity and allocate resources efficiently while students effectively meet the states’ expectation on standardized assessments. The resource allocation data used during this study represented the 2009, 2010, and 2011 academic years. The study focused on the ability of 28 elementary and middle schools from a selected school district to efficiently allocate resources and increase student achievement. The research provided evidence that suggests certain selected variables were more effective for campus efficiency scores than were others. Chapter 5 summarizes the findings by addressing the research questions posed in Chapter 1.

Findings

This study sought to use an efficiency model to help school districts become more efficient in the area of resource allocation while maintaining high student achievement. The study revealed that the selected Texas school district functioned at an efficiency rate of .96; 23 of 28 campuses functioned above 90% efficiency. The five campuses that functioned at an inefficient rate could save the district approximately $14 million over a 3-year period they adjusted their resource allocation patterns and moved from inefficient to efficient.

The common areas of concern were expenditures related to campus leadership and student support services. These findings suggest the importance of looking into the resource allocation patterns of individual campuses. The range between the minimum and maximum expenditures showed great variance between campuses. This result suggests that some campuses may not have the same resources as do others.
This study focused on the efficiency and effectiveness of each campus within a Texas school district. The Efficient and Effectiveness Framework (Daggett, 2009) represented in Figure 5 was used to illustrate each campuses’ 3-year average scores based on efficiency and effectiveness to address the research questions.

Research Question 1 was as follows: What is the status of efficient or inefficient resource use in a selected school district in Texas? This study revealed that the selected Texas school district functioned at an efficient level. During the 3-year period from 2009-2011, 13 campuses averaged efficiency scores of 100%. Additionally, 10 campuses averaged over 90% efficiency and five campuses scored in the inefficient range.

Research Question 2 was as follows: What is the affect of using data envelopment analysis (DEA) and stochastic frontier analysis (SFA) efficiency models on student achievement in a selected school district in Texas? The DEA model provided the Texas school district with an efficiency model that identified areas of concern regarding resource allocation. The model provided evidence suggesting that campuses within the selected Texas district were not allocating resources efficiently in the area of school leadership and student support services. This finding will allow campus to determine how to allocate resources more efficiently.

Elementary Results

During the 3-year period (2009-2011), the elementary campuses in the selected Texas school district functioned at 97% on average, 12 of 22 campuses (55%) functioned at 100%, and three campuses functioned below 89%. The theoretical framework showed that 19 elementary campuses fell within Quadrants B and D (efficiency), 16 campuses were in Quadrants C and D (effectiveness on the Texas Assessment of Knowledge and Skills [TAKS]), three campuses were in Quadrant A and C (inefficiency), two campuses were in Quadrant C (inefficiency and
effectiveness on the TAKS), and one campus was in Quadrant A (inefficiency and ineffectiveness).

**Effectiveness and Efficiency Framework**

Middle School Results

During the 3-year period (2009-2011) studied, middle school campuses in the selected Texas school district functioned at 93%; 1 of 6 campuses (16%) functioned at 100%, and two campuses functioned below 90%. The theoretical framework showed that four middle school campuses fell within Quadrants B and D (campuses efficiency), two campuses were in Quadrants C and D (effectiveness on the TAKS), and two campuses were in Quadrant A (inefficiency and ineffectiveness).
District Results

During the 3-year period (2009-2011), the selected Texas school district functioned at 97%; 13 of 28 campuses (46%) functioned at 100%, and four campuses functioned below 89%. The theoretical framework showed that 23 campuses fell within Quadrants B and D (efficiency), 18 campuses were in Quadrants C and D (effectiveness on the TAKS), five campuses were in Quadrants A and C (inefficiency), two campuses were in Quadrant C (inefficiency and effectiveness on the TAKS), and three district campuses fell in Quadrant A (inefficiency and ineffectiveness).

Future Research Recommendations

This study opens the door for several topics for future research. The state of Texas recently transitioned to a new state assessment, the State of Texas Assessments of Academic Readiness (STAAR). After the first 2 years of the STAAR assessment, a study regarding student achievement and campus or district efficiency would benefit districts in Texas.

This study provided evidence that campus leadership and student support services have a negative effect on campus efficiency scores. Future studies could lend ideas to how campuses can allocate resources more efficiently in both areas. This study also revealed that, even though five of 28 campuses functioned at an inefficient level, a high potential savings of $14 million exists if each campus were more efficient. Future research could identify strategies for districts and campuses to alleviate the financial burden presented by some of these function codes.

This study also focused on the importance of near real-time data. Future studies should continue this focus with importance placed on data retrieval methods. Previous efficiency related studies focused on comparisons of state results and districts within specific states. This study emphasized the importance of comparing campuses within a specific district. Future
studies that continue within this structure could take a closer look into why campuses within the same district present such a wide variance in resource allocation patterns. The information provided by future studies may help school boards, legislature, and community stakeholders make better decisions in the area of resource allocation and efficiency.

Summary

This study examined the efficiency and effectiveness of individual campuses within a selected Texas school district. The research questions focused on identifying the variables that influence campus and district efficiency. The economic crisis that Texas school districts face has made the topic of resource allocation more important than ever. As such, school district efficiency studies have increased in recent years in accordance with the dominate issues facing school districts, which include improving student performance, operating with diminishing financial resources, and making data-driven decisions (Byrd et al., 2011; Daggett, 2009). This study focused on a linear comparison of efficiency scores of each campus in a selected Texas school district during the 2009, 2010, and 2011 academic years.

The results of this study included identifying variables that had positive and negative relationships with campus efficiency scores. The selected Texas school district can use the information provided to analyze exactly how each campus allocates resources. The two variables that showed negative effects on efficiency were campus leadership and student support services. Using the DEA model, school districts can identify variances in expenditures from campus to campus. This information is important when determining the needs of individual campuses.

The theoretical framework provided a clear representation of the efficiency and effectiveness scores of each campus in the selected Texas school district. The efficiency scores
were based on the total amount of expenditures in five function codes: 11: Instruction; 12: Instructional-Related Services; 21: Instructional Leadership; 23: School Leadership; and 31: Student Support Services (e.g., counseling, testing costs, etc.). The effectiveness cores were based on each campus’s percentage of students who passed the TAKS. The average efficiency score at the elementary level was 97% and 93% at the middle school level; the district efficiency rating was 96% over the 3-year period. The framework also provided information on the number of campuses that functioned at efficient and effective ($N = 15$) and inefficient and ineffective ($N = 3$) levels.

This study took a different approach and used the DEA to determine the efficiency of a school district. Past research that has used the DEA model did so to determine the efficiency of school districts compared to other districts. This study strictly focused on comparing campuses within the same school district. The findings of study offer information that district administration, campus administration, and district stakeholders can use to make the decisions necessary to educate all children at a high level while operating efficient school campuses. Further, the information provided in this study can help all educators, stakeholders, and community members create strategies that will help campuses operate at higher efficiency and effectiveness levels.
REFERENCES


Serrano v. Priest, 487 P. 2d. 1241 (1971)


Texas Constitution. Art.7. Education §1 (2009)
