UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

THE EFFECT OF NATIONAL BOARD CERTIFICATION ON STUDENT ACHIEVEMENT IN CAREER AND TECHNOLOGY EDUCATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF EDUCATION

By

Tammie Lynn Strobel
Norman, Oklahoma
2011

THE EFFECT OF NATIONAL BOARD CERTIFICATION
ON STUDENT ACHIEVEMENT IN CAREER AND TECHNOLOGY EDUCATION

A DISSERTATION APPROVED FOR THE DEPARTMENT OF
EDUCATIONAL LEADERSHIP AND POLICY STUDIES

BY

_____
Dr. Curt Adams, Chair

_____
Dr. Gaetane Jean-Marie

_____
Dr. Beverly Edwards

_____
Dr. Courtney Vaughn

_____
Dr. William Ray

ACKNOWLEDGEMENTS

No one does it alone. I am deeply grateful to those who helped me along this journey.

I am grateful to Dr. Curt Adams who served as my advisor, teacher, and coach. You challenged me to learn beyond my comfort zone with patience and understanding. Thank you for sharing your time and expertise. I was blessed to have you as my advisor.

Special thank you to my dissertation committee who have been instrumental in helping me achieve this goal. Thank you for reading this and earlier versions, offering suggestions, lending support, and making this a life changing experience. Thank you Dr. Beverly Edwards, Dr. Gaetane Jean-Marie, Dr. Courtney Vaughn, and Dr. William Ray; you helped me achieve my best work.

I would like to express my gratitude to the Oklahoma Department of Career and Technology Education and particularly the Information Management Division Manager, Ruth Peace. You went above expectations in assimilating and formatting the data for my study. Thank you for your time and work on my behalf.

A special thank you goes to University of Oklahoma Education Administration Doctoral Cohort #1. We were pioneers, and I learned more from each of you than I ever imagined. Education reform begins with us, and I look forward to us creating innovative solutions to help students learn.

I am indebted to my colleagues at “The Best Place to Work”, Tri County Technology Center. Thank you for your understanding, support, and words of wisdom. Thank you for picking up the slack when I so often said, “I have OU today.” Johnnie, Barbara, Jeanette, Michelle, and DeeAnne, your constant encouragement meant the world to me. I could not have done it without you.

I am forever grateful to Beth, Thea, Bonnie, and Stephanie for never ending support and laughter. You were a welcome glimmer of hope in my unbalanced world. Together we have supported each other through marriages, births, deaths, divorces, career changes, and life’s journey. I have no doubt that we will share many more milestones.

A special thanks to my faithful colleague, Lindel Fields. You were instrumental in encouraging me to blaze a trail in pursuing my doctorate. We have celebrated promotions realized, licenses earned, and goals achieved. Lindel, I am grateful to have you as a friend and mentor.

I owe tremendous gratitude to my husband and best friend, Brad, whose constant encouragement and belief in my abilities was inspiring. Through your eyes, I could do anything. Thank you, Sweetheart, for supporting my dream.

I would like to thank my parents, Stan and Beverly Keefe, who taught me that anything is possible. You edited multiple dissertation versions, assisted with data entry,

provided computer support, cared for Grace; but mostly you had tremendous faith in my abilities even when I did not. It is through your unconditional love that I am the person I am today. You two are the best.

Most of all, I would like to give thanks and praise to Our Heavenly Father and His Son, Jesus Christ. His grace has allowed me to thrive through this journey with more credit than I deserve. I thank him for the gifts that He has given me and the people He has placed in my life. I pray I have the strength to be everything He has called me to be.

TABLE OF CONTENTS

Page

Page

Page

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

ABSTRACT

THE EFFECT OF NATIONAL BOARD CERTIFICATION
ON STUDENT ACHIEVEMENT IN CAREER AND TECHNOLOGY EDUCATION

Policy makers have implemented numerous reforms aimed at improving education. Teacher quality is the foundation of current education reform efforts. The National Board for Professional Teaching Standards (NBPTS) has established a voluntary system for assessing and certifying teachers with the goal of improving teacher quality and student learning. The purpose of this study was to examine the achievement effect of National Board Certified (NBCT) Career and Technology Education Teachers on student achievement. Competency test results were examined from students enrolled in Oklahoma Career and Technology Education Programs. Cross-tabulations of achievement data and Hierarchical Generalized Linear Modeling (HGLM) were used to evaluate achievement differences between NBCT and non-NBCT Career and Technology Education teachers. Limitations of the student achievement data made it challenging to confirm a relationship.

CHAPTER I

THE EFFECT OF NATIONAL BOARD CERTIFICATION ON STUDENT ACHIEVEMENT IN CAREER AND TECHNOLOGY EDUCATION

Introduction

School quality is a perennial issue in American education. At the turn of the 20th century, John Dewey (1900) described reasons to be concerned with educational improvement that are just as prevalent today. Specifically, furthering democratic ideals through a broadly educated citizenry and obtaining a viable economic future for all citizens are two reasons why school improvement matters. In the past there has been broad recognition that multiple purposes define public education, such as teaching youth how to get along in life and how to perform major adult functions. In the current reform climate, however, multiple objectives have been largely reduced to a singular focus on student achievement. This is as true for Career and Technology Education as it is for common education.

Career and Technology Education is part of the landscape of the American education system and it has been the object of much discussion and debate since the publication of *A Nation at Risk* (Gardner, 1983). Reforms immediately following the *Nation at Risk* attempted to control school improvement with new standards and testing requirements. These top-down reforms ignored classroom teachers and instructional practices as components of improvement (Hill, 1990). Three additional reports, *High*

School: A Report on Secondary Education in America (Boyer, 1983), *Horace's Compromise: The Dilemma of the American High School* (Sizer, 1992), and *A Place Called School: Prospects for the Future* (Goodlad, 1984) criticized the schools, but proposed a different solution to school improvement. Although many differences were apparent in the above reports, Hill (1990) argues the need for a "radical restructuring of American education, including the empowerment of teachers, to meet the needs of a changing society" (p. 4) was common in each report.

Additional discussion concerning school improvement continued with the reports of the Holmes Group and the Carnegie Task Force on Teaching as a Profession (Zeichner, 1991). These reports supported Boyer's (1983) assertion of teacher empowerment as a means to school improvement. The Carnegie Task Force on Teaching as a Profession recommended the establishment of a National Board for Professional Teaching Standards (NBPTS) "that would establish high standards for what teachers need to know and be able to do and to certify those teachers who meet those standards" (Harman, 2001, p. 1). The Carnegie task force recommended that education leaders come to agree about the inputs that contribute to student learning. It looked to the example of other professions for establishing standards of effective practice and found that,

> "In virtually every occupation regarded by the public as a true profession… the leading members of the profession decide what professionals in that area need to know and be able to do. They capture that knowledge in an assessment or

> examination and administer that examination to people who want a certificate saying they passed the assessment…. The certificate means the profession itself pronounces the certificate holder fully competent to perform at a high professional standard" (Carnegie Forum on Education and the Economy, 1986, p. 65).

Guided by a technical advisory group, the NBPTS set out to assess the complex performance of teaching in a way that would be "administratively feasible, professionally credible, publicly acceptable, legally defensible, and economically affordable" (Baratz-Snowden, 1993, p.2). The mission of the organization is to advance the quality of teaching and learning by recognizing accomplished teaching. In order to do this, NBPTS defined what an accomplished teacher should know and be able to do and formed their research-based core propositions of effective teaching. From these core propositions, the NBPTS developed standards that describe "the highest level of teaching in different disciplines." These standards form the basis of the assessment for teachers applying for certification (National Board for Professional Teaching Standards, 2009).

In 2000, Career and Technology Educators for the first time had the opportunity to pursue NBPTS Certification. As of June 2009, Oklahoma ranked eighth in the United States with 2,307 National Board Certified Teachers (NBCT). There were 176 Oklahoma NBCTs with Career and Technology Education Certification. Currently, there are approximately 160,000 Oklahoma career and technology education students

and 2,643 teachers, which results to a NBCT rate of 6.7 percent (Oklahoma Department of Career and Technology Education, 2009).

Statement of the Problem

Since Dewey's call for reform in the early 20th century, policy makers have implemented a number of policies aimed at improving the education of students. These policies have taken a variety of forms, but all are intended to improve teaching and learning. One prominent effort has been to develop and disseminate standards that define accomplished teaching and formally recognize teachers who meet these standards by awarding them advanced-level certification beyond the basics needed for initial licensure. The guiding assumption is that instructional effectiveness and student learning will improve and by articulating the components of high-quality practice, making these descriptions widely available, and acknowledging teachers who demonstrate these practices. Currently, two organizations in the United States are pursuing such reforms: the National Board for Professional Teaching Standards (NBPTS) and the American Board for Certification of Teacher Excellence (ABCTE). The NBPTS has been offering advanced-level certification for teachers since 1994. The ABCTE's program to certify distinguished teachers is relatively new and still under development.

The mission of the NBPTS is threefold: to establish high standards for teacher quality, to establish a voluntary system for assessing and certifying exceptional teachers, and to advance educational reforms that improve student learning (Harman,

2001). The NBPTS is an organization run by teachers and is designed to improve teaching by recognizing and advancing effective instructional practices. Accomplished teachers can achieve national certification through a process of performance-based assessments and a series of written exercises. The NBPTS standards are based on research that applies sound educational practices designed to improve student achievement (National Board for Professional Teaching Standards, 2004).

Although there is general agreement among most researchers on the effects of a NBCT on student achievement, there is also evidence that these teachers are no more effective than those without the certification (Podgursky, 2001). For example, a study on the perceptions of 260 middle school science teachers' needs and wants for a successful classroom concluded that the lack of the national certification was not necessarily indicative of the lack of effective classroom practices. However, specific practices deemed effective were not identified in the study nor were classroom observations conducted (Dagenhart, 2002).

Thus far, there has not been a significant study that measured the effect of Career and Technology Education NBCTs on student achievement. Several studies have been conducted measuring the effect of NBCTs on student achievement in common education (Goldhaber & Anthony, 2007; Cavalluzzo, 2004; Vandevoort, Amrein-Beardsley, & Berliner, 2004; Clotfelter, Ladd, & Vigdor, 2007; and Manzo, 2004), but research examining the achievement effect of NBCT in Career and Technical Education is conspicuously absent from the literature. The lack of evidence has significant

implications for policy at the state and district levels as more efforts are made to increase the number of NBCTs in Career and Technology Education.

As of June 2009, there were 176 Oklahoma NBCTs in Career and Technology Education (National Board for Professional Teaching Standards, 2009). Incentive funding provided by the state Legislature has consistently prompted more Oklahoma Career and Technology Education teachers to seek national certification. The funding provides for a $5,000 annual bonus for all full-time, publicly employed NBCTs in Oklahoma. The funding, which is $10.7 million for the current fiscal year for all Oklahoma NBCTs, also provides assistance with application fees, stipends for expenses teachers incur in seeking national certification, training with Oklahoma NBCTs and regional coordinators, and support mentors from Oklahoma universities (Oklahoma State Department of Education, 2009). Without any evidence on the efficacy of NBPTS certification on achievement in career and technology education, it is hard to know if this funding is making a difference in student learning.

Purpose of the Study

The purpose of this study was to examine the achievement effect of National Board Certified Career and Technology Education teachers on student achievement. With a large amount of state dollars allocated to increasing the number of NBCTs in career and technology education, it is important to determine if such money is being spent wisely. The following general question guided the study: Is there a difference in

student achievement attributed to students who had a NBCT compared to students who did not have a NBCT?

Assumptions of the Study

1. Data collected by the Oklahoma Department of Career and Technology Education Information Management Division is assumed accurate and valid.
2. Student level data were collected and measured without error.
3. Instructional practices between NBCTs and non-NBCTs are different.
4. Level one errors are independent and normally distributed with common variance.
5. The measure of student achievement is a binary variable as competency test data are recorded as pass or no pass.
6. Residuals are uncorrelated and have constant variance.
7. Observations across students are independent.

Limitations of the Study

All research has limitations and this study is no exception. As a quantitative study, data only report differences in student achievement and do not account for reasons why differences may exist. Additionally, it was assumed that teaching practices were different between NBCTs and non-NBCTs. Actual differences were not measured. Additional limitations of the study follow.

1. Career and Technology Education students are exposed to multiple teachers during their education. Student achievement may be attributed to more than one teacher's or person's influence.
2. The data were ex post facto. Without random selection and assignment to either the treatment or control group it is difficult to control for alternative hypotheses.
3. The establishment of one causal link does not preclude the existence of another.
4. The researcher is not objective. Among her biases, she is both a NBCT and a Career and Technology educator.
5. The study was limited to a cross-section of data collected by the Oklahoma Department of Career and Technology Education in the Summary Follow-Up Report from 2007 – 2008. Data were not longitudinal and do not report on achievement trends for teachers.
6. The measure of student achieving was limited by the design and reporting of the Oklahoma Department of Career and Technology Education Competency Test.

Definitions of Terms

The following definitions are provided to assist in interpretation and to explain terms used in this study.

Competency Test. The teacher has completed at least one of the sets of state identified, industry validated or nationally approved occupational competencies identified in the program and passed the performance standards and written exam(s), and/or passed one national certification or licensure related to the completed set of competencies (Oklahoma Department of Career and Technology Education, 2008).

National Board for Professional Teaching Standards (NBPTS). This is an independent, nonprofit, nonpartisan, and nongovernmental organization. It was formed in 1987 to advance the quality of teaching and learning by developing professional standards for accomplished teaching, creating a voluntary system to certify teachers who meet those standards and integrating certified teachers into educational reform efforts (National Board for Professional Teaching Standards, 2009).

National Board Certified Teacher (NBCT). This certification process was developed by the NBPTS to recognize excellence in teaching. An extensive series of performance-based assessments includes teaching portfolios, student work samples, videotapes, and thorough analyses of a teacher's classroom teaching and student learning. In addition, teachers must successfully complete a series of written exercises that probe the depth of their subject matter knowledge (National Board for Professional Teaching Standards, 2009).

Oklahoma Department of Career and Technology Education (ODCTE). The ODCTE is located in the north-central Oklahoma town of Stillwater. The

department provides leadership, resources, and assures standards of excellence for a comprehensive statewide system of career and technology education. The ODCTE is governed by the State Board of Career and Technology Education. They work closely with the State Department of Education and the State Regents for Higher Education to provide a seamless educational system for all Oklahomans (ODCTE, 2009).

Positive Placement. The number of students placed in the military, employed related to training, and continuing education, divided by the total number of program completers. Students that have an unknown status are not calculated in these percentages (Oklahoma Department of Career and Technology Education, 2008).

Organization of the Study

The research study is divided into five chapters. Chapter I includes an introduction, statement of problem, purpose of study, assumptions, limitations, definition of terms, and organization of study. Chapter II includes a review of the literature on Career and Technology Education, teacher quality, and the National Board for Professional Teaching Standards. Chapter III includes the research methods and procedures used in the study. Chapter IV includes an analysis of data. Chapter V considers the findings in the context of teacher quality, discusses the implications of the findings, and concludes with policy and research recommendations.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Despite more than 25 years of reforms, increased graduation requirements, high standards, and unprecedented levels of funding, increased dropout rates and stagnant achievement trends persist. Many argue that education reform must reach into the classroom to be effective (Finn, 2003). This is the objective of the NBPTS, an organization created as a result of the *Nation at Risk* and subsequent reports on educational reform. NBPTS seeks to improve teacher quality by establishing standards of teaching excellence and certifing teachers who demonstrate mastery of these standards (Darling-Hammond & Atkin, 2007; Gardner, 1983; National Board for Professional Teaching Standards, 2004). Quality teachers and quality instruction are essential for student achievement (Aaronson, Barrow, & Sander, 2007; Goldhaber & Brewer, 2000; Rockoff 2004; Wenglinsky, 2002) and studies have shown positive associations between NBCT and student achievement (Goldhaber & Anthony, 2007; Cavalluzzo, 2004; Vandevoort, Amrein-Beardsley, & Berliner, 2004; Clotfelter, Ladd, & Vigdor, 2007; Manzo, 2004).

There is no known empirical evidence linking high quality Career and Technology Education instruction and student achievement. Investigating this link was the intention of this research. To create a background for this exploration, research on

the history of Career and Technology Education, teacher quality, Goe's model for teacher quality (2007), and the NBPTS were reviewed.

History of Career and Technology Education

Career and Technology Education, formerly vocational education, has a long history. "The evolution of vocational and applied technology can be traced from the Paleolithic period, through the Neolithic period, Agricultural Civilization, Bronze Age, Iron Age and Greek Civilization and Power Age to our Post Industrial or Information Age of today" (Scott & Sarkees-Wircenski, 2001, p. 47). Long before formal schooling, students first learned to work by imitation, replication, and apprenticeships, the signature pedagogy of Career and Technical Education.

The Smith-Hughes Act of 1917 stated vocational and industrial education was of vital importance to the whole country and "for the critical years of economic development ahead of us." The Act incorporated the philosophy of Charles Prosser, and Prosser's philosophy remained the dominant force guiding vocational education until the passage of the Vocational Act of 1963 and amendments that followed. Smith-Hughes was instrumental in the formation of vocational education programs, and this foundation remains influential today (Scott & Sarkees-Wircenski, 2001). The earliest vocational programs were grounded primarily in the need to prepare more blue-collar-type students with practical skills for the nation's farms, factories, and homes (Gray, 1991).

Career and Technology Education in Oklahoma was established in 1966 through an amendment approved by voters. In May 1966, Oklahoma voters approved State Question 434, which permitted one or more school districts to form a single vocational district to be governed by its own elected vocational board. All districts were expected to build and maintain area vocational-technical schools. Property rolls from the districts were also to be combined, thereby giving each vocational school district a secure and sizable tax base. Subject to the approval of voters within each district, the vocational districts were allowed to levy up to five mills for capital construction and ten more for operating expenses (Goble, 2004).

In the 1970s, Career and Technology Education was a political response to the war on poverty and social upheaval of the 1960s. The Nixon administration came into office promising to restore social order to a nation that was deeply divided over the war in Vietnam, events of the Civil Rights movement, and the turmoil of the counter culture movement. At this time, Herschbach (2001) notes,

> "Career education was largely financed through federal vocational education money. Ignoring its overt political objective, many educators came out in support of career education because of its potential to restore balance to a school curriculum that not only seemed out of sync with the times but also appeared highly irrelevant to many students" (p.71).

In 1984 the Carl D. Perkins Vocational Education Act authorized federal funding over a five-year period to improve vocational programs and serve special

populations of students. Then in 1990, the Carl D. Perkins Vocational and Applied Technology Education Act reauthorized up to $1.6 billion a year through 1995 for vocational education. This increased federal funding reflected the continued commitment of Congress to support Career and Technology Education and reflected the education policies and reform efforts of the time. The Act placed a great deal of emphasis on the integration of Career and Technology Education and academic instruction. Congress believed that for Career and Technology Education to remain relevant and to be able to prepare students for the increasingly technological and complex jobs of the future, it would have to teach broader skills and incorporate basic academic concepts into its curriculum (Oklahoma Department of Career and Technology Education, 2006).

Today, career and technology education in America is a large and diverse enterprise. Spanning both secondary and postsecondary education, the curriculum offers programs in a wide range of subjects or program areas. Oklahoma Career and Technology Education offers programs and services in 29 technology center districts operating on 56 campuses, 398 comprehensive school districts, 25 skill centers, and three juvenile facilities (Oklahoma Department of Career and Technology Education, 2009). Although Career and Technology Education is intended to help prepare students for work, many educators and policymakers believe it has a broader mission: to provide a concrete, understandable context for learning and applying academic skills and concepts (Hoachlander, Kaufman, Levesque, & Houser, 1992). Teachers are critical

resources if this broader mission of Career and Technical Education is to be achieved, and similar to common education, improving teacher quality is an important policy target.

Conceptualization of Teacher Quality

Education researchers and policy makers recognize the importance of teacher quality for student achievement. However, defining teacher quality and measuring the degree of its existence in schools has been challenging for researchers. Despite the body of literature on teacher effects, debate persists on the relationship between specific teacher characteristics and student achievement. To better define teacher quality, it is necessary to review the evidence on effective teaching characteristics and practices. This review will first derive common elements of teacher quality from the literature. Next, it will review the empirical evidence on the relationship between elements of teacher quality and student achievement. Finally, the review will conclude by juxtaposing the evidence on effective teaching with propositions guiding NBPTS.

The landmark 1966 report, *Equality of Educational Opportunity (*Coleman, et al., 1966), suggested that "schools bring little influence to bear upon a child's achievement that is independent of his background and general social context" (Coleman et al., 1966, p. 325). This conclusion has since been contested, and numerous studies have attempted to identify school related factors that influence student achievement. Teacher quality has been the focus of many of these studies, and in recent years, has received even greater attention as states have introduced new standards for

student learning. Even though there are nuanced differences in how researchers define teacher quality and how federal and state policies measure teacher quality, common elements can be found in the literature.

Rice (2003) conducted a literature review outlining five measurable, policy-relevant teacher characteristics that are often used to define teacher quality. These characteristics included teacher experience, teacher preparation programs and degrees, type of teacher certification, specific coursework taken in preparation for the profession, and teachers' results on national achievement and aptitude tests. Wayne and Youngs (2003) examined a large body of studies that investigated the relationship between student achievement gains and teacher characteristics. They found college ratings, test scores, degrees and coursework, and certification status to be determinants of effective teaching. Common to the above teacher characteristics is the focus on objective indicators of teacher knowledge.

Darling-Hammond and Youngs' (2002) research on teacher quality focused on the importance of teacher preparation. They argued that instructional methods courses and student teaching were important contributors to teacher quality. Their research on highly qualified teachers was conducted as a direct response to Secretary of Education Rod Paige's polemical report on teacher quality where he criticized preparation programs and teacher licensing requirements (Office of Post Secondary Education, 2002). Darling-Hammond and Youngs rejected the conclusions of the Secretary's report. Specifically, they confirmed that some teacher qualifications might have more

influence on student achievement than others, those qualifications are often mediated by other teacher characteristics, such as verbal ability and content knowledge. In addition to specific inputs of teacher quality (e.g. preparation programs), Fenstermacher and Richardson (2005) categorized the concept of teacher quality into two distinct components: what teachers do (the skill of teaching) and student learning (measurable achievement). This important distinction between teaching practices and outcomes is useful when considering a definition of teacher quality.

Despite different definitions of teacher quality, there does appear to be some agreement in the literature on its constitutive elements. Darling-Hammond and Youngs (2002), Rice (2003), Wayne and Youngs (2003) assert that coursework, test scores, certifications, and other measurable teacher characteristics are determinants of teacher quality. However, objective measures of teacher preparation and aptitude alone do not account for all the elements of teacher quality. Fenstermacher and Richardson (2005) argued that conceptual, empirical and normative properties of teaching need to be explored in order to validly define teacher quality. In short, determinates of teacher quality account for teacher preparation, teacher aptitude, instructional practice, and student outcomes.

Goe's Model of Teacher Quality

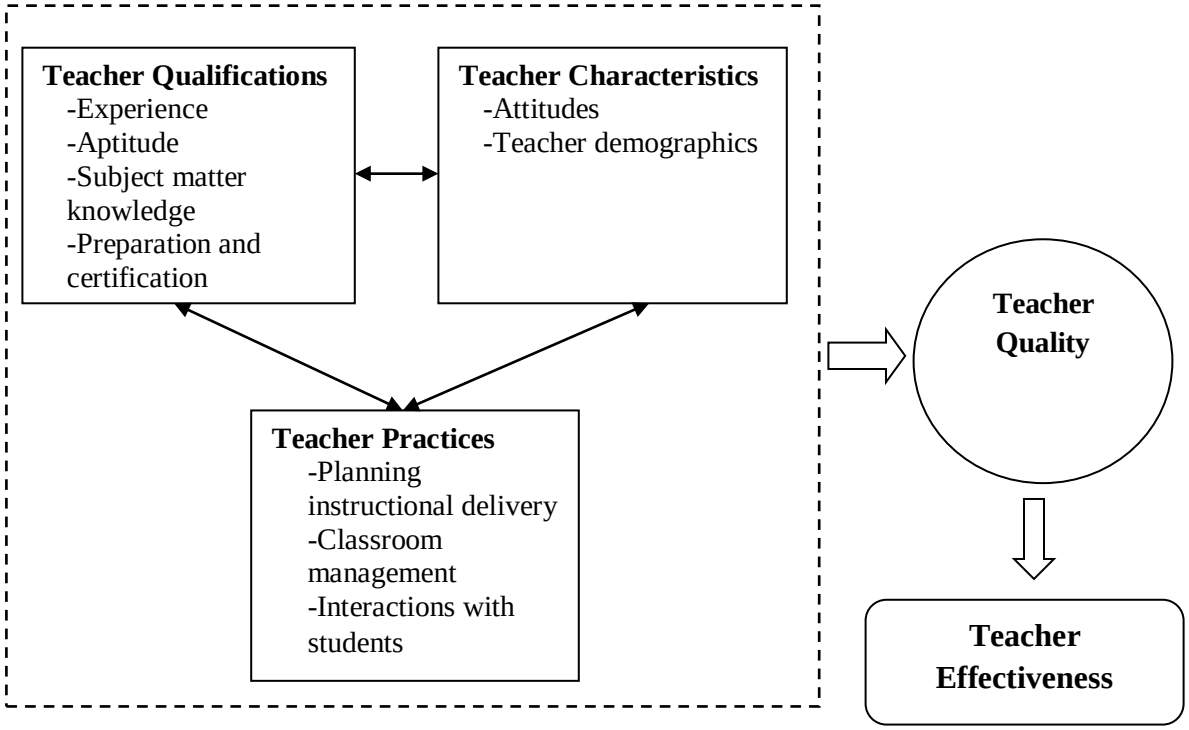
Goe's (2007) model of teacher quality combines preparation and aptitude indicators with teacher practice to conceptualize teacher quality by three distinct yet interrelated elements. Her research synthesis looked across fifty studies to identify an

empirical link between teacher quality indicators and student achievement. As illustrated in Figure 1, Goe's teacher quality indicators can be classified according to teacher qualifications, teacher characteristics, and teacher practices. The basic inputs of teacher quality, qualifications and characteristics, lead to the process of instructional practice. Qualifications refer to "paper" qualifications that are clearly quantifiable such as years of teaching experience and subject matter knowledge. Teacher characteristics refer to attitudes teachers possess, such as efficacy. Teacher practices are instructional behaviors of teachers. Specifically, teacher quality is defined for this study as the interaction of teacher qualifications, characteristics, and instructional practices that shape teacher effectiveness and student learning. The components of teacher quality and their interaction are explored in more detail.

Figure 1

Teacher Quality Model

Adapted from Goe (2007)



Goe's model presents a systematic method for exploring how teacher qualifications, characteristics, and practices interact to produce teacher quality and how teacher quality leads to teacher effectiveness. Rather than specify teacher quality as a unidimensional construct (e.g. teacher experience). Goe's model illustrates how sources of teacher quality interact to influence instructional practice in the classroom. The model shows how qualifications and characteristics of teachers feed into teaching practices. Linking the components of teacher quality in this manner accounts for myriad

factors that influence instruction. Each component has its advantages and disadvantages as a measure of teacher quality.

Important qualifications that teachers bring with them as they enter the classroom include their teaching credentials, their content and pedagogical knowledge, and their experiences (Goe & Stickler, 2008). The advantage of using teacher qualifications as an indicator of teacher quality is that it is an objective measure of instructional potential. The disadvantage is that a teacher may look good on paper but perform poorly in the classroom. A teacher may possess pedagogical and content knowledge, but lack the skill to implement this knowledge in practice. Evidence on the relationship between teacher qualifications and student achievement is mixed. Some suggest that teacher qualifications (e.g. test scores on certification examinations, subject matter knowledge, teacher preparation, and certification) have positive effects on student achievement (Rowan, Correnti, & Miller, 2002; Rockoff, 2004; Clotfelter, Ladd, & Vigdor, 2007; Strauss & Sawyer, 1986; Hill, Rowan, & Ball, 2005; Monk, 1994; Goe & Stickler, 2008; and Goldhaber & Brewer, 2000). While other evidence does not demonstrate a relationship between teacher qualifications and achievement (Betts, Zau, & Rice, 2003; Xin, Xu, & Tatsuoka, 2004)

Teacher characteristics refer to attitudes and attributes that are exemplified in teachers (Goe & Stickler, 2008). Such characteristics include race, attitude, gender, and self-efficacy. The advantage of using teacher characteristics to define and measure teacher quality is that characteristics expand the concept of teacher quality by

addressing more specific orientations that guide teacher behavior. For example, teacher efficacy is a cognitive state that enhances teacher instructional behaviors and is related to instructional effectiveness (Goddard, Hoy, & Hoy, 2000)

Unlike teacher qualification and characteristics, teacher practices attempt to account for instructional behaviors and activities that may promote student learning. Teaching practices include classroom instruction that teachers employ, such as teacher questioning strategies. Questioning strategies address ways teachers use questions to develop students' thinking skills and to measure their content mastery (Goe & Stickler, 2008). By using teaching practices to measure teacher quality, evidence on effective teaching is based on what teachers actually do in their classrooms and not solely on their characteristics and qualifications. The main disadvantage is that these practices are problematic to define and measure. In addition, it is difficult to isolate the influence of one best practice over another.

In summary, Goe's (2007) model portrays teacher quality as a complex construct that consists of interdependent dimensions –teacher qualifications, teacher characteristics, and instructional practices. Each dimension of Goe's model works interdependently to shape teacher quality and teacher quality is a necessary condition for teacher effectiveness. Next, empirical evidence on achievement differences attributed to teacher qualifications, teacher characteristics, and instructional practices is explored. The purpose in reviewing this evidence is to assess the validity of using a dimension of Goe's model to measure teacher quality.

Evidence on Teacher Qualifications and Student Achievement

Teacher qualifications control entry into the profession and are often used to determine advancements up the salary schedule. In Oklahoma, as in most states, minimum qualifications include a teacher certificate or license before being permitted to teach. Additional qualifications that are often used to measure teacher quality include teacher experience, teacher aptitude and content knowledge, and specific preparation programs. The relationship between each of these elements and student achievement is explored next.

Teacher Experience. Teacher experience is often defined by the number of years teachers have spent teaching. The evidence in general supports a relationship between experience and student achievement, but the relationship is not linear. The effect of experience on student achievement tends to level off as teachers stay longer in the classroom (Goe, 2007). That is, teaching experience does seem to matter for student achievement but only up to a certain stage of teacher development. As with much of the evidence on teacher effectiveness, the relationship between experience and student achievement is not as simple or clear as some studies might suggest. For example, there is evidence that does not demonstrate a relationship between experience and achievement (Betts, Zau, & Rice, 2003; Xin, Xu, & Tatsuoka, 2004) and evidence that does support a relationship (Rowan, Correnti, & Miller, 2002; Hanushek, Kain, O'Brien, & Rivkin 2005; Rockoff, 2004; and Clotfelter, Ladd, & Vigdor, 2007). The

inconsistent findings are explored to better understand the utility of using experience as an indicator of teacher quality.

Rowan, Currenti, and Miller (2002) in an evaluation of Title I programs found small effect sizes on reading achievement attributed to teacher experience for students in first through sixth grade. Hanushek, Kain, O'Brien, and Rivkin (2005) also discovered a relationship between experience and student achievement using data from the Texas Assessment of Academic Skills (TAAS). They found that experience predicted achievement gains but only over the first few years of teaching. Rockoff (2004) found a similar trend in New Jersey public schools. Differences in math achievement attributed to teaching experience leveled off after the first five years of teaching. That is, teacher experience mattered for student achievement with each new year of experience up to the fifth year of teaching.

Clotfelter, Ladd, and Vigdor (2007) utilized data from North Carolina to estimate the effects of various teacher attributes on student achievement. The researchers used a rich administrative data set from North Carolina to explore a range of questions related to achievement differences attributed to teachers. Though the basic questions underlying the research were not new, the availability of data on all teachers and students in North Carolina over a ten-year period was powerful. This data set allowed Clotfelter, Ladd, and Vigdor to explore relationships in more detail and with far more confidence than was possible in previous studies. They found that a teacher's experience, test scores and regular licensure all had positive effects on student

achievement, with larger effects for math than reading. Taken together the various teacher qualifications exhibited large effects on math achievement.

Evidence also suggests no effect of experience on student achievement. Xin, Xu, and Tatsuoka (2004) examined the Trends in Mathematics and Science Study (TIMSS) data for 1999 to evaluate the relative weight of experience on student achievement when accounting for other factors of teacher quality. They found that teaching experience had no effect on math or science achievement or any relationship with mathematical thinking skills. Achievement differences in their study were attributed to factors other than teaching experience.

In summary, the evidence on teaching experience as an indicator of teacher quality is mixed. Teacher experience up to a point may matter for student achievement, but the effect of experience tends to decay over time, typically after the fifth year of teaching (Rockoff, Kane, & Staiger, 2008). During the first years of teaching, teachers gain in their instructional confidence and they learn from their experiences on how best to influence student learning. After the first few years, the contribution of experience levels off (Goe, 2007). Based on the evidence, Goe (2007) argued that experience contributed differently to student achievement in the first four or five years of teaching. During these years teachers appear to gain in effectiveness with each year of teaching but student achievement gains tend to level off around the fifth year of teaching.

General Teaching Aptitude. Teacher aptitude is often measured by scores on licensure exams and other ability and intelligence type tests (Goe, 2007; Darling-

Hammond, 1999). Teacher licensure exams are intended to ensure that teachers have an adequate level of knowledge in the subject they are assigned to teach. In general, the relationship between teacher aptitude and student achievement is inconclusive. Some evidence supports a relationship while other studies found no significant relationship between teacher performance on ability and aptitude tests and student achievement (Darling-Hammond, 1999).

The earliest studies on teacher aptitude and student achievement used teacher performance on the National Teachers Examination as the aptitude measure. Particular studies of student achievement have found teacher test scores on licensing examinations to be significant predictors of student achievement. The National Teachers Examination was developed by the Educational Testing Service in the 1940's and remained the most prevalent licensing exam until it was replaced with Praxis. Summers and Wolfe (1977) conducted a study involving NTE and student achievement in Philadelphia schools. The elementary school sample consisted of 627 sixth-grade students in 103 elementary schools. Surprisingly, the study found a negative relationship between teacher scores on the NTE and student achievement. Student achievement tended to be lower for students whose teachers scored higher on NTE. Subsequent research on NTE did not confirm Summers and Wolfe's findings.

Strauss and Sawyer (1986) conducted research that did not corroborate the earlier results of Summers and Wolfe (1977). Strauss and Sawyer found that teachers' average scores on the NTE had a strong influence on average school district test

performance. The study accounted for income, race, college plans, and student teacher ratios. The findings showed that a 1 percent increase in NTE scores was associated with a 3-5 percent reduction in students failing the school district performance exam. Similarly, using district-level teacher scores on a state licensure test in Texas, Ferguson (1991) reported that teachers' performance on the licensure exam accounted for 20-25 percent of the variation across districts in student average test scores after controlling for teachers experience, student-teacher ratio, and percentage of teachers with master's degrees.

The above research presents different findings on the relationship between general teaching aptitude as measured by performance on licensure exams and student achievement. There appears to be no consistent relationship between performance on general teaching exams and student achievement. It is important to note that the evidence from general teaching exams and student achievement is relatively old. Studies linking student achievement to teacher performance on the Praxis is scarce. That stated, the varied outcomes of the literature presented suggest that perhaps teacher test scores should not be used as the sole indicator of teacher quality. There is a lot of information about teacher quality that is not measured by teacher performance on a licensure exam. While exams may measure aptitude and general teaching knowledge such tests do not capture how teachers apply their knowledge in the classroom.

Teacher Subject Matter Knowledge. Level of teacher subject matter knowledge has been used as a measure of teacher quality. Subject matter knowledge has

been measured using a variety of indicators including: coursework, college degree major, and scores on standardized exams. While few would doubt the importance of subject-specific knowledge for teacher effectiveness, direct evidence that student test performance is related to teacher subject matter knowledge has been surprisingly sparse (Darling-Hammond, 2000). The research that does exist suggests a weak, positive relationship between subject-matter knowledge and student achievement. This relationship is more evident in math where there appears to be an association between math achievement and teachers with degrees in mathematics (Harris & Sass, 2009). Similar findings are not as strong in other subject areas; however, the quantity of studies in subjects other than math is significantly less.

Hill, Rowan, and Ball (2005) found that teachers' mathematical knowledge was significantly related to student achievement gains in both first and third grades. Hill, Rowan, and Ball (2005) explored whether and how teachers' mathematical knowledge for teaching contributed to gains in students' mathematics achievement. The measure of teachers' knowledge was their score on the *mathematical knowledge of teaching* assessment. The researchers used a linear mixed-model methodology in which first and third graders' mathematical achievement gains over a year were nested within teachers, who in turn were nested within schools. They found that teachers' mathematical knowledge as measured by their exam score was significantly related to student achievement gains in both first and third grades after controlling for key student- and teacher-level covariates such as socioeconomic status.

Additional support for the relationship between teacher mathematical knowledge and math achievement comes from Monk's (1994) analysis of NAEP data. Supporting the positive evidence of subject matter knowledge on student achievement, Monk (1994) explored the relationship between the National Assessment of Educational Progress (NAEP) and teachers' subject matter expertise. He found that undergraduate coursework in mathematics and science were positively associated with higher NAEP scores on the math and science tests. For math achievement Monk's finding suggests a possible threshold of at least five math courses for higher student achievement. In science, subject matter expertise was measured by a teacher having completed at least four science courses or by completing a science major.

In short, subject matter knowledge is a teacher qualification that has been linked to student achievement largely in mathematics (Harris & Sass, 2009; Hill, Rowan, & Ball, 2005; and Monk, 1994). Through their review research syntheses Goe and Stickler (2008) found subject coursework seems to matter more in secondary education than in elementary education. Findings provide tentative support linking teacher subject matter knowledge and student achievement outcomes. However, it is also important to keep in mind that most of the research in this area has been conducted at the secondary level and in particular subjects, namely mathematics and science. Little is known whether teacher knowledge is related to student learning in other areas, such as Career and Technology Education.

Teacher Preparation and Certification. Teacher preparation and certification are often at the center of teacher quality discussions. In 2002, Secretary of Education Rod Paige argued for dismantling the teacher certification system and for redefining teacher qualifications that placed little value in traditional preparation requirements (U.S. Department of Education, 2002). Stating that current teacher certification systems impose "burdensome requirements" for education coursework that make up "the bulk of current teacher certification regimes" (p. 8), Paige's report on teacher quality argued that certification should be redefined to emphasize higher standards for verbal ability and content knowledge and to de-emphasize education training, making student teaching and most education coursework optional. Support by proponents of Paige's view of teacher preparation has resulted in several types of certification and new pathways to teaching.

There are different types of teacher certification. Full standard certification, alternative certification, emergency certification, subject area certification, and NBPTS certification have been studied in relation to student achievement. The literature concerning NBCT will be discussed at length in an upcoming section. The value of teacher preparation and certification has been found to have varied influences on student achievement. Some evidence supports a relationship between standard certification while other evidence does not.

Using data on New York City students and teachers in grades 3–8, Boyd, Grossman, Lankford, Loeb, and Wyckoff (2006) assessed the achievement effects of

different pathways into teaching in New York City. The researchers asked whether teachers who entered through new routes (e.g. alternative, emergency, etc.), with reduced education coursework prior to teaching, were more or less effective at improving student achievement. Results showed that teachers with reduced coursework in teacher education as compared to those who completed traditional teacher education programs had smaller initial achievement gains in both mathematics and language arts. In addition, variation in effectiveness within types of teacher certification was far greater than the average differences between different types of certification, suggesting that teacher effectiveness is more dependent on instructional practices and teacher characteristics than pathways to teaching.

Darling-Hammond, Holtzman, Gatlin, and Hellig (2005) examined a large student-level data set from Houston, Texas that linked student characteristics and achievement with data about teachers certification status, experience, and degree levels from 1995-2002. In a series of regression analyses looking at fourth and fifth grade student achievement gains on six different reading and mathematics tests over a six-year period, they found that certified teachers consistently produced significantly stronger student achievement gains than uncertified teachers, such as Teach for America (TFA) teachers and alternatively certified teachers. In regards to TFA, the evidence suggested that members were less effective than certified teachers and performed about as well as other uncertified teachers. TFA recruits who become certified after two or three years

did as well as other certified teachers in supporting student achievement gains; however, nearly all of them in the sample left the teaching profession within three years.

Goldhaber and Brewer (2000) found that mathematics and science students in North Carolina who had teachers with emergency credentials did no worse than elementary students whose teachers had standard teaching credentials. Goldhaber and Brewer (2000) empirically tested how 12th grade students of teachers with probationary certification, emergency certification, or no certification in their subject area compared to students of teachers who had standard certification in their subject area. In mathematics, the study found that average student achievement was higher for teachers with a standard certificate in math compared to teachers with no teaching certificate in math. Average student achievement in mathematics and science was not statistically worse for teachers with emergency credentials than teachers with standard teaching credentials.

In summary, recent debate concerning teacher certification has raised questions about whether certified teachers are, in general, more effective than those who have not met the testing and training requirements for standard certification. The value of teacher certification, experience, and preparation has not been consistently documented in the literature. The studies presented suggest that teacher certification may not be a dependable indicator of teacher quality and student achievement.

Evidence on Teacher Characteristics and Student Achievement

Teacher characteristics are often included in the discourse on teacher quality. Characteristics of teachers that shape instructional practices include a wide range of traits, attitudes, and demographic factors (Goe & Stickler, 2008). Teacher characteristics are important elements of teacher quality because they exist independently from the act of teaching. Two characteristics with the most research evidence are teacher efficacy and teacher demographics (e.g. gender and ethnicity).

Teacher Efficacy. Teacher efficacy is defined as "the extent to which the teacher believes he or she has the capacity to affect student performance" (Berman, McLaughlin, Bass, Pauly, & Zellman, 1977, p.137). Efficacy is a personal trait of an individual that undergirds self-determined action and lends to agentive behavior. Teacher efficacy is based on a teacher's perceived agency of his/her ability to affect student learning relative to the influence of external situations (e.g. student poverty). Teachers who believe they possess the capability to positively influence student achievement are more motivated to use innovative and engaging instructional techniques to bring learning to life (Tschannen-Moran & Hoy, 2001). Additionally, efficacious teachers have been found to promote student self- efficacy beliefs, to increase student motivation, and to enhance student achievement (Anderson, Greene, & Loewen; Midgley, Feldlaufer, & Eccles, 1989; and Ross, 1992).

Anderson, Greene, and Loewen (1988) examined relationships between and among teachers' and students' sense of efficacy, thinking skills, and student

achievement. Twenty four Canadian teachers in Grades three and six and 584 students completed a test of reasoning skills and an efficacy scale at the beginning and end of the school year. Students also completed the Canadian Achievement Tests and a measure of their teachers' classroom behavior. Teachers were interviewed at the beginning and end of the year. Relationships among student thinking, efficacy, and achievement were confirmed, suggesting that teacher self- efficacy beliefs at the beginning of the year affected student achievement.

Midgley, Feldlaufer, and Eccles (1989) examined the relationship between students' belief in mathematics and their teachers' sense of efficacy. Teacher efficacy was measured using a questionnaire assessing a wide range of beliefs including trust and respect for students. The longitudinal study of 1,329 students found that students who moved from high efficacy to low efficacy math teachers entered with lower expected perceived performance. In others words students with teachers that possessed a lower comparative efficacy perceived their mathematics performance would be lower than students of higher efficacy teachers.

Ross (1992) tested relationships between student achievement (knowledge and cognitive skill), teacher efficacy, and interactions with assigned coaches (self-report measures) in a sample of 18 seventh and eighth grade history teachers in 36 classes implementing a specific innovation with the help of six instructional coaches. Teachers who relied on school administrators to solve problems had lower efficacy and reported less involvement with their coaches. Student achievement was lower for the less

efficacious teachers. Conversely, student achievement was higher in classrooms of teachers who had more contact with coaches and greater confidence in their instructional effectiveness.

Teacher Demographics. In the few studies on the relationship between teacher demographics and student achievement, the literature suggests a tenuous link between student achievement and being assigned to a teacher of the same race (Dee, 2004). Dee (2004) compared the achievement of students assigned to teachers of the same race with similar students who were assigned to teachers of a different race. Students in the same grade and in the same school were randomly assigned to different teachers' classrooms. Dee contrasted same race achievement results with different race achievement results using data from Tennessee's Student Teacher Achievement Ratio (STAR) Project. She concluded that the positive effects of being assigned to a teacher of the same race appear to increase as children progressed through school. In other words, the longer a child is assigned a teacher of the same race the greater the effect on student achievement.

While a large body of research focuses on achievement and gender of students, less research explores the relationship between a teacher's gender and student achievement. Research that does exist suggests that the gender of the teacher may influence how boys and girls are treated in the classroom. A large literature base establishes that boys and girls are treated differently in the classroom (Chaplain, R., Miles, S. and Rudduck, J., 1994; Eccles, J.S. and Blumenfield, P. Wilkinson, L. C.

and Marrett, C. B., 1985). Research suggests that treatment also depends on the gender of the teacher. Krieg (2002) followed a large subset of Washington 3rd graders over a two-year period that concluded with students completing the Washington Assessment of Student Learning (WASL). The WASL is the standardized test the state of Washington has chosen to employ to comply with the No Child Left Behind Program. Combining test results with specific teacher information provided a comprehensive data set that allowed Krieg to assess the relationship of student and teacher gender on standardized test results. His evidence suggested that although disciplinary procedures, perceptions of gender differences, and interactions with students differed between teachers by gender, these differences did not result in differential test scores between boys and girls.

Regardless of student gender Krieg (2005) found that students of male teachers performed worse than students of female teachers. Students of male teachers were 2.7 percent less likely to pass the WASL than students of female teachers. Krieg estimated that male teachers had students that failed the WASL with 6.9 percent greater frequency than female teachers. The reasons for this disparity were not the focus of Krieg's research, but he does conjecture that it is possible that parents or principals placed lower ability students with male fourth grade teachers leading to higher estimated failure rates in the complete sample model.

Chudgar and Sankar (2005) investigated the relationship between student learning outcomes and the presence of women teachers in Indian classrooms. The analysis showed that male and female teachers differed in terms of their classroom

management practices and their belief in students' learning ability. In partial support of the policy of hiring female teachers, the study also showed that being in a female teacher's classroom was advantageous for language learning but teacher gender had no effect on mathematics learning.

Even though some evidence suggested achievement differences by teacher gender and efficacy, there is more to quality teaching than measures of teacher cognitive beliefs and demographic characteristics can capture. Using teacher characteristics as the sole criterion for teacher quality does not capture the comprehensiveness of the instructional process. Teacher effectiveness is shaped by many factors some teacher qualities and others based on the social context not related to teacher characteristics.

Evidence on Instructional Practices and Student Achievement

In addition to measures of teacher qualifications and characteristics, the literature points to practices both in and out of the classroom that affect student achievement (Goe, 2007). These practices encompass teaching behaviors and student-teacher interactions in the classroom (Stronge, Ward, Tucker, & Hindman, 2007). Research presented on teacher practices investigates the relationship between student achievement and practices teachers utilize such as lesson preparation and classroom management.

Stronge, Ward, Tucker, and Hindman (2007) conducted a study to analyze instructional behaviors and practices associated with student learning. Ordinary least

squares (OLS) regression analyses and hierarchical linear modeling (HLM) were used to identify teacher effectiveness levels while controlling for student-level and class/school-level variables. Achievement data from the Virginia Standards of Learning Assessment for 1,936 third grade students with achievement results in English, Mathematics, Social Studies, and Science were analyzed. The observation team also evaluated how third grade teachers carried out practices associated with instruction, student assessment, classroom management, and personal qualities. Key findings indicated that effective teachers scored higher across all four of the above instructional domains. Additionally, effective teachers tended to ask a greater number of higher level questions (e.g., analysis) and had fewer incidences of off-task behavior than ineffective teachers. Teachers with higher student achievement tended to also be more effective at preparing lessons, managing student behavior and learning, and monitoring student progress.

Busatto (2004) explored educational practices that made a difference in primary students' achievement in numeracy in 45 government and nongovernment schools in New South Wales. The research used case studies based on interviews, observations of classroom instruction, and examinations of school documents. The team of researchers found that the factors making a difference in achievement included language as a focus for learning and assessments used to identify and accommodate ability differences. The most effective teachers employed hands-on materials, small group instruction, open-ended questions, discussion during the lessons, differentiated teaching and learning, and

considerable interaction between teachers and peers. The recommendation of the researchers was to draw on these findings to improve numeracy across all schools.

Wenglinsky (2002) based on his review of the teacher quality literature, argued that the greatest influence on student achievement comes from classroom practices and the professional development that supports them. Wenglinsky notes "regardless of the level of preparation students bring into the classroom, decisions that teachers make about classroom practices can either greatly facilitate student learning or serve as an obstacle to it" (p. 7). That is, teacher pedagogical decisions and activities (which were separate from, but not unrelated to teacher subject matter knowledge) independently make a difference in student achievement. Pedagogical decisions considered in Wenglinsky's analysis include assessment method (e.g. traditional or authentic), level of questioning (e.g. high or low order), and instructional delivery (e.g. hands on).

In conclusion, given the evidence presented, it is apparent that measuring teacher quality through teacher qualifications, teacher characteristics, and instructional practices as separate components is not sufficient. Teacher quality is an interconnected and constantly changing condition that is shaped by preparation experiences, teacher characteristics, instructional practices, and the social context of teaching. Using only one part of Goe's model as an indicator of teacher quality does not account for the myriad factors affecting teaching and learning. All three interconnected domains are necessary to adequately assess teacher quality. Next, the National Board for

Professional Teaching Standards will be evaluated to determine how well the process of obtaining Board certification aligns with the dimensions of teacher quality.

National Board for Professional Teaching Standards

In May of 1986, The Carnegie Task Force on Teaching as a Profession recommended the establishment of a National Board for Professional Teaching Standards (NBPTS). The charge of the Board was to "establish high standards for what teachers need to know and be able to do and to certify those teachers who meet those standards" (Carnegie Forum on Education and the Economy, 1986, p. 46). NBPTS is an independent, nonprofit, nonpartisan, and nongovernmental organization governed by a board of directors, the majority of whom are classroom teachers. The certification process is unlike the current mandatory systems of state licensing that set entry-level requirements for beginning teachers and school counselors. NBPTS certification is a voluntary process developed by teachers, school counselors, and other education stakeholders to recognize experienced educators for the quality of their practice. NBPTS certification signifies that a teacher or school counselor has met challenging professional standards as evidenced by performance-based assessments on content knowledge and instructional competencies deemed necessary for effective performance in their certification area (National Board for Professional Teaching Standards, 2009).

NBPTS arose from a report by the Carnegie Task Force on Teaching as a Profession that called for the formation of a non-profit private organization to create a new form of teacher certification, separate from state certification systems (Carnegie

Forum on Education and the Economy, 1986). The board's mandate was to raise the professional status of teachers and the quality of teaching by creating a means to identify and certify the most accomplished teachers. The NBPTS likes to compare itself to the medical specialty boards. All doctors are licensed by their states, but most also obtain advanced training and voluntary certification from one of the 24 medical specialty boards. The NBPTS sees itself as providing a similar form of advanced certification, a signal of teaching expertise and excellence. The Carnegie Foundation provided the NBPTS start-up funds, but beginning in the early 1990s, the U.S. Department of Education became the NBPTS primary source of support (Podgursky, 2001).

Forming NBPTS spanned several years. From 1987 to 1993, time and energy were mostly consumed with laying the foundation, guidelines, and regulations for the credentialing organization. By 1994, the NBPTS offered only two areas of certification: Early Adolescence/English Language Arts and Early Adolescence/ Generalist. In 1995, the first teachers to earn NBCT totaled only eighty-one. As of 2009, there were nearly 74,000 NBCTs across all certificate areas.

The number of certification areas has increased giving more classification of teachers the opportunity to pursue NBCT. In 1995, only two areas of certification were offered. Currently, the NBPTS offers certificates for teachers, librarians, and counselors. In addition, beginning in 2011, NBPTS will offer Advanced Principal Certification. In total, NBPTS offers 25 certificates that cover a variety of subject areas

and student developmental levels, and are applicable to more than 95 percent of America's teachers. The certificate is available in 16 subject areas and is classified into seven student age categories. As a candidate, the teacher can opt for a generalist certificate or one that is subject-specific. Certificates available are listed in Table 1. (National Board for Professional Teaching Standards, 2009).

Table 1

NBPTS Certificates Available

Subject	Student Developmental Level
Art	• Early and Middle Childhood • Early Adolescence through Young Adulthood
Career and Technology Education	• Early Adolescence through Young Adulthood
English as a New Language	• Early and Middle Childhood • Early Adolescence through Young Adulthood
English Language Arts	• Early Adolescence • Adolescence and Young Adulthood
Exceptional Needs Specialist	• Early Childhood through Young Adulthood
Generalist	• Early Childhood • Middle Childhood
Health	• Early Adolescence through Young Adulthood
Library Media	• Early Childhood through Young Adulthood
Literacy Reading Language Arts	• Early and Middle Childhood

Mathematics	• Early Adolescence • Adolescence and Young Adulthood
Music	• Early and Middle Childhood • Early Adolescence through Young Adulthood
Physical Education	• Early and Middle Childhood • Early Adolescence through Young Adulthood
School Counseling	• Early Childhood through Young Adulthood
Science	• Early Adolescence, Adolescence and Young Adulthood
Social Studies History	• Early Adolescence, Adolescence and Young Adulthood
World Languages Other than English	• Early Adolescence through Young Adulthood

Acquiring NBPTS certification is a voluntary process that provides teachers an avenue to attain an advanced certification that has implications for their career and for student learning (Helms, 2001). The NBPTS certification process takes at least one year and approximately $2,300 for a teacher to complete. There are three components to the NBPTS Certification process: initial selection criteria, preparation of a professional portfolio, and computer administered written assessment. The initial selection criteria include a bachelors' degree from an accredited higher education institution, a state teaching license, and three years teaching experience. The portfolio includes videotaped teaching situations along with samples of student work. The crucial component is the written reflection each candidate completes regarding his or her practice. Candidates

also submit artifacts to document their involvement with families and the community. Fellow teachers who are trained and screened by the NBPTS assess teacher entries.

Career and Technical Education NBPTS Certification

The 1999-2000 school year marked the first year of NBPTS certification eligibility for Career and Technology Education teachers. Approximately 580 Career and Technology teachers were initial NBCT candidates that year. Of those, 413 completed the process and 248 across the nation were the first to receive their NBCT in Career and Technology Education. Table 2 below illustrates the growth of Oklahoma NBCTs (National Board for Professional Teaching Standards, 2009). As the table on the following page shows, the number of Oklahoma Career and Technical Education NBCTs has increased from 2 teachers in the year 2000 to 176 teachers by 2008.

Table 2

Summary of Oklahoma

Career and Technology Education NBCTs

Year Certification Earned	**Number of Certificates Earned**	**Total NBCTs**
2000	3	3
2001	25	28
2002	16	44
2003	16	60
2004	17	77
2005	17	94
2006	23	117
2007	38	156
2008	20	176

The Early Adolescence through Young Adulthood/Career and Technology Education Certificate is the NBCT Certificate appropriate for Career and Technology educators. Candidates in this area are required to select one of eight specialty cluster areas:

1. Agriculture and Environmental Sciences
2. Arts and Communications

3. Business, Marketing, Information Management, and Entrepreneurship
4. Family and Consumer Sciences
5. Health Services
6. Human Services
7. Manufacturing and Engineering Technology
8. Technology Education

The Career and Technology Education NBPTS criteria include documentation of standards in creating a productive learning environment, advancing student learning, helping students transition to work and adult roles, and improving education through professional development and outreach. Each Standard contains specific elements. The elements for creating a productive learning environment include knowledge of students, knowledge of subject matter, learning environment, and diversity. The elements for advancing student learning include advancing knowledge of Career and Technology subject matter and assessment. The elements for helping students transition to work and adult roles include workplace readiness, managing and balancing multiple life roles, and social development. The elements for improving education through professional development and outreach include reflective practice, collaborative partnerships, contributions to the education profession, and family and community partnerships (National Board for Professional Teaching Standards, 2006).

NBPTS Core Propositions

The mission of the NBPTS is to advance the quality of teaching and learning. After an extensive review of the literature on teacher quality, along with evidence from other professions, the Carnegie task force developed five core propositions on teacher quality that guide the assessment process for NBPTS certification. The teacher-developed standards in each certificate area are centered on the propositions that have direct applicability to classroom practices (Benz, 2000). Shakowski (1999) described National Certification as a credential attesting the teacher has been assessed by peers as one who is accomplished, makes sound professional judgments, and acts in accordance with those judgments. He maintained that the standards of the NBPTS are evident in all areas of their teaching and learning, including high expectations, knowledge of the standards, curriculum, and goals, and the ability to modify instruction to meet the various abilities and needs of students in the classroom.

The five core propositions are: (1) teachers are committed to students and their learning; (2) teachers know the subjects they teach and how to teach those subjects to children; (3) teachers are responsible for managing and monitoring student learning; (4) teachers think systematically about their practice and learn from experience; and (5) teachers are members of learning communities. The next sections summarize the core propositions and links them to evidence on teacher quality. The purpose of such a review is to assess the utility of using NBCT as an indicator of teacher quality.

First Proposition. The first core proposition is based on the belief that teachers who are committed to their students and their learning are more effective in the classroom. It is the belief of NBPTS that teachers need to make knowledge accessible to all students, and that all students can learn. This proposition is embodied through instructional practices that respect the myriad differences among students. The NBPTS assessment measures the degree to which teachers treat students equitably by accounting for students' individual needs. Differentiation and cultural sensitive teaching are instructional practices promoted by the NBPTS. To be effective in the classroom, teachers should respect the cultural and family differences of students, and teachers should be concerned with the holistic needs of their students, such as their self-concept, motivation, and social relationships. NBCTs are also concerned with the development of character and civic responsibility in students (National Board for Professional Teaching Standards, 2009).

Proposition one aligns with Goe's (2007) teacher quality model on the importance of teacher characteristics for effective instruction. Teachers who are committed to their students and their learning demonstrate specific teacher characteristics described by Goe (National Board for Professional Teaching Standards, 2009). Teacher characteristics are frequently included in descriptions of teacher quality but are often not measured. All are viewed as related to teacher quality according to Goe "because they exist independently of the actual art of teaching" (Goe & Stickler, 2008, p. 6). These concepts are also supported by research conducted by Frome,

Lasater, and Cooney (2005) that used data to measure 11 teacher qualities of effective instruction. Among the qualities that were significantly and positively related to student achievement were teacher motivation and expectations for students. The researchers concluded that higher student ratings for motivation and teacher expectations correlated with higher achievement. Teachers demonstrate commitment to learning and student achievement through their attitude towards students and their own abilities to be a conduit of learning. These results support NBPTS proposition one and Goe's teacher quality model's contribution to teacher effectiveness.

Second Proposition. The second core proposition asserts that teachers have subject matter knowledge and that they have mastered the skills required to teach the subject. NBPTS believes that teachers should be subject matter experts. This proposition is based on the belief that to be effective, teachers must have a deep understanding of the history, structure, and real-world applications of the subject they teach. Teachers must be familiar with the skill gaps and preconceptions students may bring to the subject in order to meet the individual needs of each student. The NBPTS assesses each teacher's diverse instructional strategies and his/her ability to teach for understanding (National Board for Professional Teaching Standards, 2009).

Proposition two links to Goe's (2007) teacher quality model of teacher qualifications and teacher practices. Teachers who have subject matter knowledge and have mastered the skills required to teach the subject exhibit strong teacher qualifications and instructional practice in Goe's model. It is one thing to possess

knowledge and another to deliver it effectively. A teacher's subject matter knowledge has also been linked to student achievement by Goldhaber and Brewer (2000). Goldhaber and Brewer conducted a study examining the teacher certification status, subject matter knowledge, and their relationship to student achievement. They found that students of teachers who had a degree in mathematics performed better in mathematics than students whose teachers did not have a degree. The NBPTS Certification process seeks to measure both subject matter knowledge and the effectiveness by which teachers deliver learning in their classroom.

Third Proposition. The third core proposition deals with the process of teaching itself. Teachers are accountable for guiding and monitoring student learning. NBPTS recognizes that superior teachers deliver effective instruction. Teachers move fluently through a range of instructional techniques, keeping students motivated, engaged, and focused. To increase student engagement and to ensure a disciplined learning environment, effective teachers know how to organize instruction to meet instructional goals. The NBPTS assessment measures the degree that teachers know how to assess the progress of individual students as well as the class as a whole. NBCTs have demonstrated that they can use multiple methods for measuring student growth and understanding, and can clearly explain student performance to parents (National Board for Professional Teaching Standards, 2009).

Proposition three aligns with the instructional practice dimension of Goe's teacher quality model (2007). Teachers who are accountable for guiding and monitoring

student learning demonstrate practices of effective teaching (National Board for Professional Teaching Standards, 2009). Assessment and feedback is one practice that is associated with student achievement (Schacter & Thum, 2004). Schacter and Thum (2004) examined 12 dimensions of teaching practices in an effort to determine the relationship between teacher variation and student achievement gains. The dimensions include aspects of the teaching process itself from planning to delivery to assessment. Their results strongly supported the hypothesis that more learning takes place in classrooms with higher levels of observed practices of quality teaching. These results support NBPTS proposition three and Goe's teacher quality model processes of teacher practices.

Fourth Proposition. Proposition four is based on the belief that teachers think systematically about their practice and learn from experience. NBCTs should be an example of what it means to be continually learning: they read, they question, they create, and they are willing to try new things. Teachers are scientists in the art of instruction. To be effective, teachers should be familiar with learning theories, instructional strategies, and stay abreast of current issues in American education. Using learning theory, NBCTs critically examine their practice on a regular basis to deepen knowledge, expand their repertoire of skills, and incorporate new findings into their practice (National Board for Professional Teaching Standards, 2009).

NBPTS fourth proposition also aligns with the teaching process of Goe's (2007) model. Teachers who think systematically about their practice and learn from

experience demonstrate practices of effective teaching. Research on teacher practices investigates the relationship between student achievement and the practices teachers employ (National Board for Professional Teaching Standards, 2009). Cohen and Hill (1998) provided evidence that activities designed to change instructional practice may affect student achievement. The researchers used a teacher self reported instructional practices assessment and determined their relationship to performance on the California Learning Assessment System. These results support the influence of professional development on teacher instructional practice and student achievement.

Fifth Proposition. The fifth proposition is based on the community of educators to which teachers belong. NBCTs collaborate with others to improve student learning. Teachers are community leaders and actively know how to seek and build partnerships with community groups and businesses. In addition, teachers share resources with fellow educators on instructional policy, curriculum development, and professional development. Teachers can evaluate their school's progress and the allocation of resources in order to meet state and local education objectives. NBCTs work in collaboration with parents to engage them productively in the objectives of the school.

This core proposition aligns with Goe's teacher quality model (2007) and links with her description of the process of teaching. Teachers who collaborate with others to improve student learning demonstrate practices of effective teaching (National Board for Professional Teaching Standards, 2009). Kannapel and Clements (2005) conducted research designed to determine what made high-performing high-poverty schools

different from other high-poverty schools. Differences were noted in a number of areas, but the most significant finding was collaborative decision-making among teachers and ongoing job embedded professional development can increase student achievement.

As stated by NBPTS, the five core propositions, "frame the rich amalgam of knowledge, skills, dispositions, and beliefs that characterize National Board Certified Teachers" (National Board for Professional Teaching Standards, 2009, p. 33). The teacher-developed standards in each certificate area are centered on propositions that have direct applicability to effective classroom practices (Benz, 2000). Shakowski (1999) described National Board Certification as a credential certifying that the teacher has been assessed by peers as one who is accomplished, makes sound professional judgments, and acts in accordance with those judgments. He maintained that the NBPTS standards are criteria for all areas of effective teaching and learning.

In conclusion, educators and researchers have long debated the school variables that influence student achievement the most. The educational literature has established teacher quality as one of the most powerful determinants of student achievement. With such an established relationship between teacher quality and student achievement, federal, state, and local districts are designing polices to increase teacher quality as a means of improving school performance. National Board Certification is one popular policy used by states to improve instruction. The rising popularity of NBCT makes it important to take stock of its effect on student achievement.

There has only been one study on the effectiveness of national teacher certification conducted in the context of Career and Technology Education, and it was a small mixed methods study of nine Business Education NBCTs (Leatherwood, 2004). Because the evidence on the effectiveness of NBCTs in Career and Technology Education is scant at best, it is important to turn to the evidence from the K-12 literature to understand the effects of NBCT on student achievement. Several studies provide empirical evidence about the relationship of NBCTs and student achievement.

Evidence on NBCT and Student Achievement

Evidence confirming the link between NBCTs and student achievement in K-12 schools comes from four large studies that each found a relationship between NBCT status and student performance on standardized tests (Cavalluzzo, 2004; Goldhaber & Anthony, 2007; Smith, Gordon, Colby, & Wang, 2005; Vandevoort, Amrein-Beardsley, & Berliner, 2004). The studies are similar in that they link NBCT status to positive student achievement outcomes. The studies differ by research design and data sets.

Vandevoort, Amrein-Beardsley, and Berliner (2004) analyzed four years of SAT scores in reading, language arts, and mathematics for elementary students in 14 Arizona school districts. In the 48 comparisons they made (four grades, four years of data, three measures of academic performance), students in the classes of NBCTs surpassed students in the classrooms of those who were not NBCTs in nearly three quarters of the comparisons. Nearly one-third of these differences were statistically significant. Effect size estimates suggested that students of NBCTs were on average one month ahead of

the students of non-Board certified teachers. Vandevoort, Amrein-Beardsley, and Berliner concluded that NBCTs were on average more effective teachers in terms of academic achievement. The results of this study provide support for policies that promote NBCT as a mechanism to improve teacher quality.

Goldhaber and Anthony (2007) examined the relationship between NBCT status and teacher contribution to student achievement in North Carolina from 1996 - 1999. A total of 416 unique, current, and future NBCTs were included in the analysis. The researchers examined whether NBPTS assessed the most effective applicants, whether certification by NBPTS served as a signal of teacher quality, and whether completing the NBPTS assessment process served as a catalyst for increasing teacher effectiveness. Findings for both reading and math achievement suggested that the contribution of future NBCTs to student achievement exceeded that of teachers who did not eventually become NBPTS certified. Results indicate that before teachers go through the certification process they are often more effective than the teacher who does not consider certification. The size of the achievement differential suggests that having a teacher who intends to obtain national certification, as well as teachers who eventually obtain NBCT, boosts student achievement gains by up to 0.10 standard deviations per year for the average student.

Goldhaber and Anthony suggest that NBPTS certification provides a valid signal of teacher effectiveness. In addition to finding that future NBCTs (prior to applying for certification) were more effective than the non-NBCT, Goldhaber and

Anthony found that future NBCTs were disproportionately effective with minority and free and reduced lunch (FRL) students. Their findings, while in support on NBCT, raise questions about the value added from the NBPTS certification process.

Cavalluzzo (2004) provided an analysis similar to Goldhaber and Anthony with achievement data from ninth and tenth grade students in Florida's Miami-Dade County. She examined the association between student gains in mathematics in the ninth and tenth grades from 2000-2003 using NBCT status and other indicators of teacher quality. She also observed the instructional practices of 61 NBCTs and 101 applicants in the process of obtaining NBCT. Her results were similar to those of Goldhaber and Anthony in that NBCTs were more effective than other teachers in boosting student math achievement; however, the effect size attributed to NBCT was smaller. Additional findings indicated achievement differences for free and reduced lunch students but not minority students.

Perhaps the most revealing finding in Cavalluzzo's study was related to NBCT and teachers who attempted but did not earn NBCT. She found there were no differences in student achievement between teachers who applied and were rejected for NBPTS certification and those who became NBPTS certified. This evidence raises more questions about the value of the certification process: Does the process contribute to better teaching or are teachers who seek national board certification simply more effective? Completing the NBPTS process itself may not result in improved teaching

and increased student achievement, but such a certificate may be an indicator of teacher quality.

Additional research suggested student learning gains can be attributed to the NBPTS Process. Smith, Gordon, Colby, and Wang (2005) examined the relationships between student achievement and NBCT status. Participants were recruited from across the United States in four certificate areas. A total of 64 teachers from 17 states participated in the study. Thirty-five (55 percent) of the participants had achieved National Board Certification, and 29 (45 percent) had attempted but had not achieved National Board Certification. The overall findings from this study indicated that the relationship between student learning outcomes and NBCT status was statistically significant. The comparative teaching practices dimension of the study also found that NBCTs emphasized a deeper understanding in their instructional design and classroom assignments.

Although there is some agreement among researchers on the positive effects of a NBCT on student achievement, there is also evidence that these teachers are no more effective than those without the NBPTS certification (Stone, 2002; Podgursky, 2001). Stone (2002) used standardized exams to investigate the relationship between the NBCT status of teachers and their students' achievement. His study investigated whether NBCTs in Tennessee were exceptionally effective in bringing about student achievement gains. The achievement measure came from the Tennessee Value-Added Assessment System (TVAAS). TVAAS is a statistical analysis of achievement data that

reveals academic growth over time for students and groups of students, such as those in a grade level or in a school (Webb, 2010). Stone found that all NBCTs in the sample fell short of being rated as exceptional teachers by the TVAAS indicator. Stone concluded that NBCT teachers were only average producers of student achievement (Stone, 2002).

Podgursky (2001) also found the NBCTs were no more effective than non-NBCTs. Based on data from Missouri public school teachers, he argued that at best the NBPTS certification tells the public that the teacher knows how to be a good teacher, but not that he/she put the theory into practice. Researchers and policymakers need to prove the value of the NBPTS certification process. Although studies may show that NBCTs are more effective than non-NBCTs, they do not show they are more effective than they would have been without the certification process (Archer, 2002). Criticism of the NBPTS certification process is voiced by some because of the sole emphasis on what teachers know and should be able to do. These critics insist that it is more important to emphasize what they are able to accomplish in terms of student achievement (Schalock, Schalock, & Myton, 1998).

In summary, the previous evidence in general seems to be mixed about the effects of NBCT on student achievement. Some evidence strongly supports the effects of NBPTS certification, but other evidence raises questions about the contributions of the certification process to teacher effectiveness. Relative to other indicators used to measure teacher quality (e.g. experience, degree level, etc.) NBCT comes closest to

capturing the dimensions of Goe's model of teacher quality. NBCT accounts for qualifications, teacher experience, teacher aptitude, and instructional practices as demonstrated by the five NBPTS core propositions. The five core propositions set clear benchmarks for effective teaching, and they collectively identify the values, beliefs, and assumptions underlying good teaching (Berg, 2003). Although NBCT is more comprehensive than teacher experience or characteristics, there are limitations for using NBCT as the sole measure of teacher quality. In short, NBCT fails to measure the ongoing process of teaching. The NBPTS process captures a snapshot of a teacher's proficiency in the form of a computer assessment and portfolio entry, but it does not provide continuous, systematic evidence of effective instructional practices.

CHAPTER III

RESEARCH METHODS

Introduction

Incentive funding provided by the state legislature is prompting more Oklahoma career and technology teachers to seek National Board Certification. The funding provides for a $5,000 annual bonus for all full-time, publicly employed NBCT educators in Oklahoma. The funding, which was $10.7 million for fiscal year 2009-2010, also provides assistance with application fees, stipends for expenses teachers incur in seeking national certification, training with Oklahoma NBCT teachers and regional coordinators, and support mentors from Oklahoma universities (Oklahoma State Department of Education, 2009). Without any evidence on the efficacy of NBCT as a policy mechanism to improve student achievement in Career and Technology Education, it is difficult to know if this funding is making a difference in student learning.

The proposed purpose of this study was to examine the effect of National Board Certified Career and Technology Education teachers on student achievement. With a large amount of state dollars allocated to increasing the number of NBCTs in Career and Technology Education, it is important to determine if such money is being spent wisely. The general research question for this study was is there a difference in student achievement attributed to students who had a NBCT compared to students who did not have a NBCT?

Research Design

This study used ex post facto data from the Oklahoma Department of Career and Technical Education to determine if there were achievement differences attributed to NBCT. Ex post facto research is less expensive and faster than other research designs (Fraenkel & Wallen, 1996). Due to the historical nature of the data, alternative explanations for achievement differences would need to be addressed by including possible confounding variables in the models (Leedy & Ormond, 2005). For this reason, student characteristics, such as minority and poverty status, and teacher characteristics, such as years of experience and degree, were included as predictor variables. To answer the research question for the study, data were collected and analyzed from Oklahoma Career and Technology Education teachers. The data source, sampling approach, measures, and analytical techniques utilized are described in the next sections.

Data Source

The population for this study included all students and teachers in Oklahoma Career and Technology Education during the 2007-2008 school year. The total population was approximately 160,000 students and 3,000 teachers. Data were multi-level with students nested in classrooms. Teacher data, student data, and demographic data for this study were obtained through the Oklahoma State Department of Career Technology Education. Teacher data collected through the Human Resources Division included NBCT status and degree level of teachers. Student achievement data are

collected annually from teachers in each Career and Technology Program and linked to teachers in a state data file.

Individual teachers enter their own student achievement data into the Information Management System. Teachers collect and enter student success data concerning program completion, retention status, continuing education status, employment status (including hourly wage earned), and competency test pass status. Data are also collected pertaining to student race and socio-economic status. The Oklahoma Department of Career and Technology Education and the local school district audit data for accuracy.

Sampling Approach

The study employed stratified random sampling to randomly select Career and Technology Education teachers with National Board Certification and non National Board certified teachers from three fields: Business and Information Technology, Health Occupations Education, and Family and Consumer Sciences. Stratified sampling involved dividing the sample into subgroups in this case the subgroups were Career and Technical Education disciplines (O'Leary, 2004). These disciplines were selected because they had the most NBCTs. The sample was reduced to approximately 1,500 teachers and 78,000 students by narrowing the sample to the above fields. To further reduce the sample, a randomization table was used to randomly sample a proportionate number of NBCT and non-NBCT. Additionally, Non-NBCTs with less than three years of experience and teachers without bachelor's degrees were eliminated from the sample

because National Board eligibility requires a bachelor's degree and a minimum of three years teaching experience. Teachers with less than 10 students and teachers with more than 100 students were also eliminated from the sample. These decisions resulted in a sample of 150 NBCT and 1,150 non-NBCT.

From the remaining teachers, 36 NBCT and 36 non-NBCT were randomly sampled using a randomization table. Because teachers varied by discipline, a proportional number of teachers were sampled from Business and Information Technology, Health Occupations Education, and Family and Consumer Sciences. The final sample consisted of 72 total teachers (36 NBCT and 36 non-NBCT) and 1,588 students.

Measures

Data were examined at the student and teacher level. The researcher obtained 2007-2008 student achievement data from the Oklahoma Department of Career and Technology Education. Student achievement was measured using competency test Pass Rate as defined by the Occupational Completer Rate.

Competency test data are collected consistently in every program area through the Oklahoma Department of Career and Technology Education Testing Division. The test is developed, maintained, and administered by the Testing Division. The assessment is measured on the same scale regardless of the Career and Technology Education Program – pass or fail. Raw scores are not entered in the system. The teacher indicates

if a student passed or did not pass a test depending on whether or not the student scored a 70% or better.

The Oklahoma Department of Career and Technology Education competency test is similar to an End of Instruction (EOI) test in public comprehensive schools. The competency test is administered at the end of instruction for an occupational area. Each Career and Technology Education program has at least one competency test associated with the program. For example in Computer Aided Drafting (CAD) there are three possible competency tests while Marketing Management uses only two possible competency tests. The CAD competency tests are Drafting Technician, Mechanical Drafter, and Architectural Drafter. Particular Career and Technology Education programs have multiple competency tests because a competency test is linked to a specific occupation.

Competency exam scores determine the occupation completer rates. The definition of an Occupational Completer is any student that completed at least one of the sets of state identified, industry validated or nationally approved occupational competencies identified in the program and passed the performance standards and written exam(s), and/or passed one national certification or licensure related to the completed set of competencies (Oklahoma Department of CareerTech Education, 2008).

Analytical Techniques

Several statistical procedures were used in the analysis of data. These statistics provided both a holistic description of students and teachers in the sample and determined whether significant relationships existed between NBCT and student achievement. Descriptive statistics were calculated for the majority of the variables. Descriptive data reported on student and teacher characteristic.

A cross-tabulation was performed first to explore the possible relationship between NBCT and competency exam pass rate. Cross-tabulation is appropriate when the independent and dependent variables are dichotomous, as was the case with data for this study. Muijs (2004) notes, cross tabulation estimates the expected relationship between two variables by calculating the expected results of an outcome for a specific group compared to the group's actual results. That is, cross tabulation reported the number of NBCT students who passed or failed the competency exam compared to the expected number of NBCT students pass or fail. The chi-square test was used to test the significance of the relationship.

Cross tabulation can provide modest evidence on a relationship between two dichotomous variables, but it does not control for other factors that could intervene in the relationship. To control for intervening variables, such as student poverty status, Hierarchical Generalized Linear Modeling (HGLM) was used. HGLM is a special case of Hierarchical Linear Modeling (HLM) and was an appropriate analytical technique due to the nature of the data. Student acheivement was measured as a binary outome.

With binary data, the predicted value of the outcome cannot be normally distibuted because of the predicted value of pass or fail (Raudenbush & Bryk, 2002).

When applying HGLM, three conceptual premises exist: 1) Nested data are prevalent in education research with teachers assigned groups of students in classes; 2) Nested data can be analyzed at multiple levels; and 3) Nested data have multiple sources of variance (Mashburn, 2009). The HGLM design isolated the relationship between NBCT and student achievement, controlling for alternative hypothesis. As Wang (1999) argues,

> "Hierarchy is a fundamental characteristic of many psychological and social phenomena. In studies of school effects, we often wish to explore and test ideas concerning the ways in which the differences between districts, schools, or classrooms in terms of policy and practice, influence process occurring within these organizational units" (p. 1).

For the HGLM, the unconditional model estimated the number of successful trials in the number of possible attempts. Thus, the number of students passing the competency exam given the total number of students taking the exam. The unconditional model estimates the effects of teacher and student characteristics on the odds of passing the competency exam. Student characteristics were poverty, as measured by free and reduced lunch qualification, and minority status. Teacher characteristics were NBCT status and years of experience. The primary teacher variable was NBCT. The model tested in this study is presented below.

Yij/Φij~*B*N(*nij*, Φij)

nij =ln[(probability of success)/ (1-probability of success)] = ln (odds)

Level I Structural Equation

μij = [1/(1+*e (-nij)*)] = β0 + β1 (poverty)

Level II Structural Equation

β0 = γ00 + *u0*

β1 = γ10

Where Yij is the number of successful trials and Φij is the probability of success, *nij* is the natural log of success. The level I structural model is the log of success for a given teacher (β0) and the log of success for a student qualifying for the lunch subsidy (β1). Level two equations capture the random effects. This is the variability in the log of success across teachers (Raudenbush & Bryk, 2002).

Based on findings from the HGLM, two post-hoc analyses were performed. First, a cross tabulation was performed on the relationship between minority status and passing or not passing the competency exam. This cross tabulation was conducted in an effort to confirm the relationship between minority status and achievement found in HGLM analysis. The cross tabulation computed the actual minority pass rate to the expected minority pass rate. Second, a logistic regression was performed to determine if the NBCT and achievement relationship could be modeled at the student level.

Summary

The research methods selected were designed to study differences in student achievement attributed to NBCTs in Career and Technical Education. The data source was obtained from the Information Management Division of the Oklahoma Department of Career and Technical Education. Student data were acquired from the 2007-2008 Student Follow-Up Report and teacher data were obtained through the Human Resources Division. Stratified random sampling was used to draw the student sampled. The measure of student achievement was the Oklahoma Department of Career and Technology Education Competency Test. The Competency Test is administered to all Career and Technology Education Students as a measure of student achievement. Analytical techniques used in the study were descriptive statistics, cross tabulation, and HGLM. Descriptive statistics were used to describe the basic features of the data used in the study. Cross tabulation was used to estimate the expected results of students with NBCT passing the competency test compared to the actual rate. HGLM tested the probability of a student with an NBCT passing the achievement test after controlling for student characteristics and other teacher characteristics. Results of these analytical techniques are reported in the next chapter.

CHAPTER IV

ANALYSIS OF DATA

Introduction

Chapter 4 presents evidence on the research question: Is there a difference in student achievement attributed to students who had a NBCT? This chapter will first present descriptive data on the student level and teacher level variables. Student level variables were used as controls so that any differences in student achievement could be isolated to differences among teachers, specifically between NBCT and non-NBCT status. Student minority and economic status were accounted for because these characteristics are repeatedly demonstrated in research to be related to student achievement. The primary teacher variables were advanced degree and NBCT status. Results from the cross tabulation estimated the actual pass rate of students with NBCTs compared to the expected pass rate of these students. Hierarchical Generalized Linear Modeling (HGLM) results are reported to evaluate differences in the probability of passing the competency exam that were attributed to having a NBCT teacher. The chapter concludes with results from the post-hoc cross tabulation analysis that was used to examine the relationship between race and achievement.

Descriptive Data

Student level data are presented in Table 3. The mean for each variable represents the percentage of students that were represented in the overall sample. Thus, a mean of .36 for minority classification indicates 36 percent of the students in the

sample were identified as minorities. Minority status included those whose ethnicity was African American, American Indian, Asian, Hispanic, or Other. Conversely, 64 percent of the students in the sample were Caucasian. In 2008, the minority status for all Oklahoma Technology Centers was 74 percent of the student population was Caucasian, while 26 percent were classified as minority (Oklahoma Department of Career and Technology Education, 2009).

A mean of .96 for competency exam indicates that 96 percent of the students passed the exam in their respective discipline (business education, health education, etc). The remaining 4 percent did not pass the exam. A pass rate of 96 percent for students in the sample limits the amount of variability in the measure for achievement. A mean of .36 for poverty indicated that 36 percent of the sample qualified for the federal lunch subsidy, a good representation of the poverty rate in the population. In 2008 the poverty rate for all Oklahoma Technology Centers was 31 percent (Oklahoma Department of Career and Technology Education, 2009). Finally, a mean of .52 indicates that 52 percent of the students in the sample had an NBCT.

Teacher data are also presented in Table 3. A mean of .50 indicates that approximately half of the 72 teachers in the sample were NBCTs. A mean of .57 indicates that 57 percent of the teachers had an advanced degree (Master's or Doctorate) and 43 percent held a Bachelor's degree.

Table 3

Descriptive Statistics for Student and Teacher Variables

Variable	M	SD	Min	Max
Student Level (n=1,588)				
Minority Classification	0.36	0.48	0	1
Pass/Fail	0.96	0.20	0	1
Poverty	0.36	0.48	0	1
NBCT	0.52	0.49	0	1
Teacher Level (n=72)				
NBCT	0.50	0.50	0	1
Advanced	0.57	0.50	0	1

The correlation matrix (Table 4) displays the relationship between passing the competency exam and student characteristics. Notice in the table that NBCT was treated as a student level characteristic. Results suggest that there was a small, positive relationship between having an NBCT and passing the competency exam ($r = .22$, $p<.05$). Further, free/reduced lunch students and minority students tended to have a lower pass rate than non free/reduced lunch and non-minority students.

Table 4

Correlations Between Student-Level variables and Passing the Competency Exam

	Pass	**F/R Lunch**	**Minority**	**NBCT**
Pass	1.0	-.09	-.05	.22**
F/R Lunch		1.0	.79*	-.03
Minority			1.0	-.04
NBCT				1.0

Cross Tabulation Analysis

Results of the cross tabulation are reported in Table 5. A cross tabulation was performed to determine if the actual pass or fail rate for students with a NBCT was consistent with their expected pass/fail rate. Cross tabulations calculate the actual pass rate compared to the expected rate by assessing the proportion of students with NBCT teachers in the sample who passed the exam compared to the overall pass rate for the entire sample of students. Results indicate that NBCT students passed the competency exam at a rate exceeding what was expected and failed at a lower rate than expected.

The number of NBCT students expected to pass the competency exam was 800.6. The actual number of students that passed was 837, a difference of nearly 37 students. Equally, the number of NBCT students who were expected to fail based on the overall pass rate was higher than the actual number of NBCT students who failed. The expected number of students to fail was 36.4, but no students actually failed the exam.

The data for the non-NBCT's students show a different relationship. The expected pass total for non-NBCT students was 718.6, but only 682 actually passed, a difference of 37 students. The number of students with non-NBCTs that failed was expected to be 32.6 but 69 students actually failed the exam. Thus, more non-NBCT failed and less passed than what would be expected based on the overall pass rate in the sample. In short, NBCT students were more likely to pass the competency exam than non-NBCT students, corroborating bivariate correlation results. Based on the cross tabulation it appears there was a relationship between students with NBCT and their probability of passing the competency exam.

Table 5

NBCT Student Status Cross Tabulation

Variable	Expected Pass	Actual Pass	Expected Fail	Actual Fail	N
NBCT Student	800.6	837	36.4	0	
Non-NBCT Student	718.4	682	32.6	69	
Totals	1519	1519	69	69	1588

While the cross tabulation presented evidence on a relationship between NBCT students and their probability of passing the competency exam, it does not test the likelihood that this relationship is a function of chance or is likely to hold in the population of Career and Technology Education students (Muijs, 2004). A chi-square test was performed to determine if the relationship between having a NBCT and passing the competency exam was statistically significant; in other words, are we confident the relationship found in the sample is likely to exist in the overall population? The chi-square test determines the likelihood that this relationship would occur in the overall population. A chi-square test is an appropriate technique when the dependent variable is a binary outcome (Hoy, 2007; Muijs, 2004). In the case of student achievement,

students either passed or failed the competency exam; achievement was not measured as a continuous variable.

Results suggest that the difference between NBCT students and non-NBCT students passing the exam was significant (X^2=80.4, P>.01), and not likely to be a result of sampling or chance. That is, there appears to be a relationship between NBCT teachers and student achievement that would exist in the overall population of Career and Technology Education students in Oklahoma. The strength of this relationship relative to other variables that correlate to achievement differences, however, is unknown. Other teacher characteristics or student characteristics that could explain differences in student achievement were not controlled in the cross tabulation. For this reason a more powerful analysis that can control for plausible intervening student and teacher characteristics was performed.

Multilevel Analysis

While cross tabulation found a significant difference in the pass rate of NBCT and non-NBCT students, the test is not a robust technique because it does not account for other determinants of achievement. Student or teacher characteristics could also explain achievement differences in the sample of Career and Technology Education students and not including these variables in the model increases the chances of making a type I error, rejecting the null hypothesis when it is true. Multilevel analysis, on the other hand, is able to control for confounding variables by including them in the model and evaluating the net effect of NBCT on student achievement (Raudenbush & Bryk,

2002). Recall from chapter three that HGLM is a type of multilevel model that is appropriate for binary outcomes and data at multiple levels. HGLM was utilized to delve deeper into the data analysis by examining the pass rate across students and teachers.

Results of the HGLM confirmed initial concerns about low variability in the pass rate. Recall that approximately 96 percent of the students passed the competency exam. This high pass rate complicated efforts to model variability in the pass-rate across teachers. Specifically, only about 2 percent of the variability in passing the competency exam was at the teacher level (Table 6). This was not a significant amount of variability to warrant testing a conditional model at the teacher level.

Table 6

HGLM Unconditional Model: Variation Between Teachers in Student Odds of Passing the Competency Exam

Characteristic	**Pass Rate**	**Df**	**Chi-square**
Between-School Parameter Variance	.02	71	18.02

Note: variability in the pass rate are odds ratios as calculated from HGLM Beta coefficients

Because variance in pass rate at the teacher level was not significant, the researcher was interested in determining if differences in student poverty and minority classification contributed to the small difference in the pass rate. Results in Table 7 with the federal lunch subsidy qualifications (FRL) and minority status entered as student level predictors indicated that poverty and minority status decreased the odds of passing the competency exam by about by .02 for poverty students and approximately .04 for minority students.

Table 7

Final Estimation of Fixed Effects for Poverty and Minority Status

Fixed Effect	Coefficient	Standard Error	T-Ratio	P-Value	Confidence Interval
Poverty	-0.02	0.551585	0.863	0.389	(0.546,4.744)
Minority	-0.04	0.459465	-1.315	0.189	(0.221,1.345)

Post-Hoc Analysis

The rationale for conducting a post hoc analysis was that the HGLM seemed to suggest that student background characteristics influenced pass rates. Two analyses were performed. First, because minority status had the largest effect, a cross-tabulation post hoc analysis was conducted to determine the differences in expected and actual

pass rate for minority and non-minority students. Second, a logistic regression was performed with NBCT set as a student characteristic, not a teacher characteristic. The logistic regression corrected for the problem of limited teacher level variability.

The data presented in Table 8 for the cross tabulation analysis illustrates the expected pass rate presented for minority students based on the proportions found in the sample. It appears that Caucasian students passed at a rate that exceeded what was expected. The expected number of Caucasian students forecasted to pass the competency exam was 969. The actual number of students who passed was 976. Equally, there seemed to be a significant relationship with those students who were expected to fail. The expected number of Caucasian students predicted to fail was 44 while the actual number of students failing the exam was 37. The data for the minority students confirms the findings. The expected minority student pass count was 550 while only 543 actually passed. The number of minority students who failed was expected to be 25 and 32 students actually failed the exam.

More analysis on the relationship between student background characteristics and student achievement in Career and Technology Education is needed. Results of this study suggest that achievement differences may exist between minority and non-minority students, but the differences were not as large relative to cross-tabulation findings with NBCT as the independent variable. Similarly, the bivariate correlations found a stronger relationship between NBCT and passing the competency exam.

Table 8

Minority Status Cross Tabulation

Variable	Expected Pass	Actual Pass	Expected Fail	Actual Fail	N
Caucasian Student	969	976	44	37	
Minority Student	550	543	25	32	
Totals	1519	1519	69	69	1588

Logistic regression results confirm the plausible difference in passing the competency exam based on student background characteristics. Results also shed light on the statistical problems associated with limited variability in the achievement measure. As table 9 reports, being minority and qualifying for the free lunch subsidy reduced the odds of passing the competency for students in the sample. Specifically, the odds of passing decreased by -.54 for poverty students and -1.2 for minority students. Unlike the HGLM results, both differences were statistically significant. Model two illustrates the statistical problem of limited variability. When NBCT is entered as a predictor in model two the beta coefficient is large but not significant, essentially pointing to a colinearity problem that prevents the variance/covariance matrices from converging.

Table 9

Logistic Regression Results

Variable	Model 1	Model 2
Constant	4.2 (.33)**	3.38 (.34)**
Minority	-1.19 (.34)**	-1.30 (.34)**
Poverty	-.54 (.25)*	-.33 (.26)
NBCT		36.23 (78933587)

Note: *p<.05, ** p<.01

Summary

Perhaps the most revealing finding was the percentage of students passing the ODCTE competency exam. Approximately 96% of the 1,588 students in the sample passed the exam. With such a high pass rate there was very little variability to explain. For this reason cross tabulation was used to assess the actual compared to the expected pass rate of students with NBCTs and those students without NBCTs. Results provided modest evidence of a potential relationship between NBCT and student achievement in the sample, as well as a relationship between student characteristics and achievement. Cross tabulation results corroborated HGLM findings and findings from the logistic

regression suggesting that student background characteristics were possible factors in student achievement on the competency exam. A discussion of these findings along with implications for policy and recommendations for future studies is addressed in the next chapter.

CHAPTER V

DISCUSSION

Introduction

Career and Technology Education, formerly Vocational Education, is in transition. Historically, the purpose of Career and Technology Education has been to prepare students for entry-level jobs in occupations requiring less than a baccalaureate degree. Over the last 10 years, however, this purpose has shifted toward broader preparation that develops the academic, career, and technology skills of students in Career and Technology Education programs so that they will be prepared for a rapidly changing workforce. The traditional focus of Career and Technology Education is giving way to a broader purpose-one that includes greater emphasis on academic preparation and provides a wider range of career choices (National Center for Education Statistics, 2000). Traditional Career and Technology Education programs, such as carpentry, which emphasized employment in a specific trade, are evolving into programs that now educate students for a range of careers in broader industries, such as construction or technology. New programs, like computer networking and pre-engineering are being created to educate and prepare students for careers involving sophisticated scientific and technological skills, knowledge, and aptitude. Today, more than half the students who concentrate in Career and Technology Education also take a college preparatory curriculum (Oklahoma Department of Career and Technology Education, 2009).

As the purpose for Career and Technology Education evolves, the need for quality programing with quaility teachers also expands. One response to increased press for teacher quality was the advent of the National Board for Professional Teaching Standards (NBPTS) for Career and Technical Education teachers. Established in 1987, NBPTS is part of the growing quality education movement in common education that targets teacher quality as the mechanism for reform. Like other NBPTS certification areas, Career and Technology Education became a certificate option in 1990. Career and Technology Education teachers who achieve National Board Certification have met high standards through study, expert evaluation, self-assessment, and peer review (National Board for Professional Teaching Standards, 2009).

Oklahoma's Comission for Teacher Preparation supports NBPTS certification through training, and monetary resources for application fees and annual salary bonuses. Training includes pertinent workshops with the Oklahoma Commission for Teacher Preparation, Southeastern Oklahoma State University, and Regional NBPTS certification Coordinators. The training incorporates elements of the NBPTS certification process. The goal of training is for teachers to be prepared to complete successfully the application submission and ultimately become NBCTs. Additional funding to support mentors from Oklahoma universities is provided for teachers seeking National Board certification.

Monetary support from the State of Oklahoma is significant. Each successful NBPTS candidate receives full funding for the $2,500 application fee and a $5,000

annual salary stipend (as per regulation and funding) for the ten-year life of their NBCT (Oklahoma Commission for Teacher Preparation, 2010). As of 2008, there were 176 Oklahoma Career and Technology Education NBCTs. These teachers collectively are eligible for approximately $440,000 in application fee support and $8,800,000 in annual salary stipend for a total investment of $9,240,000. As these numbers suggest, the investment in NBPTS certification has been significant.

Several studies have been conducted on the relationship between NBCT and student achievement in K-12 settings (Amrein-Beardsley, & Berliner, 2004; Cavalluzzo, 2004; Clotfelter, Ladd, & Vigdor, 2007; Goldhaber & Anthony, 2007; Manzo, 2004; and Vandevoort, 2004) but research examining the achievement effect of NBCTs in Career and Technology Education is absent from the literature. The evidence found in K-12 generally seems mixed. Several researchers have demonstrated that students with NBCTs achieve at higher levels than their counterparts with teachers without NBPTS certification (Vandevoort, Amrein-Beardsley, & Berliner, 2004; (Goldhaber & Anthony, 2007; Cavalluzzo, 2004; and Smith, Gordon, Colby, & Wang, 2005). The lack of conclusive evidence in Career and Technology Education combined with varied evidence in K-12 has significant implications for educational policy at the state and district levels.

The general question guiding the study was whether or not there was a difference in student achievement attributed to students who had a NBCT. Even though results do not warrant any definitive claims, the findings have implications for

policymakers and leaders in Career and Technology education. The purpose of the discussion section is to examine findings in the context of teacher quality research, as well as to consider implications of the findings for Career and Technology Education. The section begins with a discussion of results through Goe's (2007) model of teacher quality, the conceptual framework of the study. Policy recommendations and suggestions for future research are then advanced.

Teacher Quality

Teacher quality as conceptualized in Goe's (2007) model is shaped by teacher qualifications, teacher characteristics, and teacher practices. These factors account for inputs into teacher quality (e.g. teacher preparation), individual characteristics that influence teacher behaviors (e.g. experience), and instructional practices that define the teaching environment in classrooms. National Board Certification is often used as an indicator of effective instructional practices. As previously mentioned, NBCTs demonstrate their instructional ability through a battery of assessments that measure teacher content knowledge and teaching competencies. Unlike licensure exams that test for basic knowledge to enter the profession, National Board ostensibly certifies effective teaching.

The National Board certification process is based on high and rigorous standards that evaluate teaching practice through performance-based assessments. The assessment process for NBCT requires candidates to complete two major components: a portfolio of classroom practice including samples of student work and videotapes of teacher

instruction, and an assessment of content knowledge administered at a computer-based testing center. It is estimated that the NBPTS certification application process takes the better part of a school year to complete and involves a total of 200-400 hours of work outside of the classroom.

Overall, findings from this study do not lead to any definitive claims about the relationship between NBCT and student achievement in Career and Technology education. The cross tabulation and correlational analyses seemed to suggest a plausible relationship between NBCTs and student achievement. However, cross tabulations and correlations do not account for other determinants of student achievement, such as student background characteristics. Results from the more robust Hierarchical Generalized Linear Model did not support the cross-tabulation findings. The estimated difference in student achievement at the teacher level was extremely small. A reason for the lack of difference is likely to be the small variability in student achievement. The descriptive data depicted a competency exam pass rate of 96% for students in the sample, a surprisingly high pass rate.

With almost no teacher level variability in achievement, two additional HGLM analyses were conducted using poverty and minority classification as fixed effects. Although it was not the intent of this study to analyze the effects of minority status and poverty on Career and Technical Education student achievement, the data seemed to show that student background characteristics, similar to common education, could also

explain achievement differences in Career and Technical Education. The relationship was not large but it is one that can be explored with additional data.

What conclusions can be drawn from the findings about teacher quality and the National Board certification process? First, even if the findings were not limited by the achievement measure more evidence would be needed on why and how the National Board process enhances instructional practice. Is it that the certification process adds value to teacher quality or quality teachers are attracted to national certification? Goldhaber and Anthony (2007) examined the relationship between NBCT status and teacher contribution to student achievement. Findings suggested that the contribution of future NBCTs exceeded that of teachers who are not National Board certified. Results indicate that before teachers go through the NBPTS certification process they are often more effective than teachers who do not consider certification. Goldhaber and Anthony's (2007) research supports the assertion that completing the NBPTS process in of itself may not increase teacher effectiveness.

Second, given Goe's (2007) model of teacher quality, National Board would best measure instructional qualification, not teacher characteristics or instructional practices as the propositions may seem to suggest. Inferences could be made about teacher characteristics and instructional practices of NBCTs but these would not be as reliable as having proximate and ongoing evidence about one's teaching. The NBPTS certification process measures a teacher's ability to complete a written examination and document, through a portfolio submission, evidence demonstrating mastery of the

NBPTS Five Core Propositions. The Five Core Propositions form the foundation for what all accomplished teachers should know and be able to do (National Board for Professional Teaching Standards, 2009). But, the NBPTS certification process does not measure actual ongoing teaching practice. Teaching practice consists of an amalgam of components including planning, instructional delivery, classroom management, and interactions with students (Goe, 2007). At best, National Board certification considers a snap-shot of those activities, not ongoing regular instructional practice.

Important considerations for policymakers and leaders of Career and Technical Education are mechanisms to support teacher quality. Given the evidence on the sources of teacher quality, along with the inconclusive evidence from this study, it does not make sense to rely on National Board Certification as the primary policy tool to promote teacher quality. For instructional leaders in Career and Technology Education, teacher quality is of particular importance. Without quality teachers, it will be difficult to achieve the higher expectations and broader purpose of preparing college and career ready students. Leadership efforts to increase Career and Technical Educational quality have not been consistent. There are pockets of success, best practices, and anecdotal evidence concerning the influence of instructional leaders on teacher quality, but true scientific research is absent from the literature. In addition, knowledge regarding the components of the schools who have successfully implemented strategies to increase teacher quality has been minimal.

Teacher quality is a human and social condition that needs to be nurtured within Career and Technology Educations Centers through policies and practices that support instructional improvement and professional growth. Policies that attempt to control teacher quality at a district and state level are likely to be effective if they support the establishment of learning communities within schools (McLaughlin & Talbert, 2006), effective instructional supervision (Zepeda, 2006), meaningful professional development (Borman & Kimball, 2004), and compensation models that attract and retain committed and motivated professionals. Such approaches have empirical support for their effects on continuous improvement in common education (Smylie, 2010). Career and Technical Education can learn from effective practices in common education.

Recommendations for Policy

The recommendations from this study must be viewed from a particular set of research conditions in the study. As with most research, it is important to look at each study within the context of the entire body of research rather than an isolated finding. With this in mind, two features of this study have particular implications for policy: the conceptualization of teacher quality and limitations of the achievement measure. Two policy recommendations advanced are improvements to the competency test and fiscal accountability.

Improvements to the Competency Test

This study examined student achievement in terms of performance on the Oklahoma Department of Career and Technology Education competency test. This test is the only standardized measure used by all Oklahoma Career and Technology Education teachers. To better assess the contribution of teachers or schools to student achievement, a more valid and reliable assessment needs to be developed. The current measure of student achievement is outdated. The competency test does not adequately measure differentiated student achievement. The overall pass rate for the exam of the 1,588 students sampled was 96%. The competency exam is created by Career and Technology Education teachers in each occupational area. Teachers collaborate to write the exam with no specific preparation other than their respective teacher preparation. A standardized exam created and administered by a third party would perhaps be a better measure of student achievement.

One such assessment that could be employed as either a replacement or a complement to the current test is the nationally recognized ACT Work Keys assessment. ACT is renowned for its assessment measure of high school students' general educational development and their capability to complete college-level work. Work Keys is an additional assessment offered by ACT that measures job skills and competencies that help employers select, hire, train, develop, and retain a high-performing workforce. Work Keys assessments measure "real world" skills that are critical to job success. These skills are valuable for any occupation and at any level of

education (ACT, 2010). Oklahoma Career and Technology Education could employ this assessment to assess the general competencies and preparedness of students to succeed in a 21st Century work environment.

Another recommendation for the competency exam is the manner in which scores are reported in the Oklahoma Department of Career and Technology Education data collection system. Currently, student achievement is reported as a binary outcome; students either pass the exam (with a 70 percent or greater) or fail the exam (below a 70 percent). To get a clearer picture of student achievement, data should be reported as a continuous variable and results should reflect how students performed on different standards for the respective discipline. The exact test score the student receives should be entered into the Oklahoma student data management system. Continuous data would allow for a more comprehensive data analysis on student performance.

Additional policy recommendations relating to the competency test data concerns the Oklahoma Department of Career and Technical Education data collection process. Presently, each Career and Technology Education teacher enters data for his/her own students. Teachers have the opportunity to enter false information or create accidental errors in data entry when there are no checks or balances for how data are entered or monitored. The Oklahoma Department of Career and Technology Education needs an updated data management structure where an automated system populates student data by teacher. The current procedure is not adequate given the gaming found

in common education (Baker, et al., 2010). More procedures and parameters are needed to guard against unethical practices in reporting achievement data.

Fiscal Accountability

The second policy recommendation pertains to fiscal accountability for policies aimed at improving teaching and learning in Career and Technology Education. The fiscal outlay for Oklahoma to support NBCTs is significant. National Board teachers are collectively eligible for approximately $440,000 in application fee support and $8,800,000 in annual salary stipends (for the ten-year life of the certificate) for a total financial investment of $9,240,000. Nationwide billions of dollars are spent to pay NBPTS application fees, bonuses, and to organize training workshops with little evidence that it leads to significant gain in student achievement. Oklahoma is not the only state with significant investments in National Board Certification. Table 6 summarizes the financial support other states provide for National Board Certification (National Board for Professional Teaching Standards, 2009).

Table 10

Financial Investment in Support of NBPTS Certification

State	Financial Investment
California	The proposed 2010 Budget Act includes $3 million for NBCTs teaching in eligible high-need areas
Colorado	Included additional money for National Board Certification as part of the effort to develop effective teachers and principals in low performing schools in its Race to the Top application
Florida	$1,900
Illinois	NBCTs who mentor candidates for at least 60 hours earn a $3,000 bonus
Louisiana	$5,000 salary supplement
Maine	$3,000 stipend
Mississippi	$6,000 stipend
New Mexico	$5,800 per year salary differential for each year of certification
North Carolina	Adopting a provision that grants each

	NBCT candidate twelve months of respite before having to repay a loan for the application fee
Ohio	Education reform plan positions NBCTs to climb their way to the state's top license. Among the recommendations is that National Board Certification qualifies as one of two pathways to the state's top license.
South Carolina	$5,000 salary supplement
Tennessee	Received Race to the Top funding and is working closely with NBPTS to assure their standards are integral to teacher evaluation
Washington State	$5,000 base bonus plus a $5,000 high-needs bonus

Limited evidence exists that NBPTS certification is a worthwhile fiscal investment for the State of Oklahoma. Without conclusive evidence on the achievement effect of NBCT, continuing to allocate millions of dollars annually for a policy that is unproven is hard to justify. More research is needed to understand the factors that

contribute to quality student learning in Career and Technical Education and how policies can support quality performance. New assessment and performance measures systems will be needed to better evaluate the implementation and effectiveness of improvement policies in Career and Technical Education. These systems can learn from the quality movement that transformed industry and is improving the quality of patient care in health care (Kenny, 2008).

A central principle of the quality movement is the measurement of process and outcomes. The reality is that improvement policies do not always work (Honig, 2009). Having access to evidence on processes and practices can enhance leaders' ability to improve the delivery of teaching and learning in Career and Technical Education. Current measurement systems in Career and Technical Education are inadequate to supply school administrators with the type of comprehensive information that is needed to make decisions about continuous improvement.

Recommendations for Further Research

There is little debate among researchers that teacher quality is an important contributor to student achievement. While numerous researchers have contributed to the literature linking teacher quality and student achievement, additional research is needed to examine Career and Technology Education student achievement and NBPTS certification. This study had limitations due to student achievement data constraints and research design. Specifically, additional research can explore the relationship between

NBPTS certification and Career and Technology Education student achievement. Three recommendations for future research address limitations of this study.

Career and Technology Education student achievement was measured by performance on multiple-choice Oklahoma State Department of Career and Technology Education competency tests. This exam is created by Oklahoma Career and Technology Education teachers and is administered by the Oklahoma Department of Career and Technology Education. Results might have been different if a more rigorous standardized measure for student achievement that could account for variability in student performance was used. In addition, the competency exam is a paper pencil exam that measures cognitive knowledge. The exam does not measure the hands on skills that Career and Technology Education students acquire through their program. The study could be replicated using alternative measures for student achievement.

The second recommendation for future researchers is to use a more rigorous research design. This study used ex post facto data from a cross section of Oklahoma Career and Technology Education teachers during one school year. Students were already assigned to either a NBCT or a non-NBCT. Future research could use a randomized control trial by randomly sampling and assigning students to either a NBCT or a non-NBCT. Such a design could better control for threats to validity.

The final recommendation is to conduct a qualitative study comparing the instructional practices of Career and Technology Education NBCTs to those of non-NBCTs. It was beyond the scope of this study to delve deeper into the instructional

practices of Career and Technology Education NBCTs. Quantitative designs can test the relationship between NBCT and student achievement but they cannot examine differences in instructional practices. Not only is it important to study NBCT teachers in the classroom, it is also necessary to explore the contribution of the National Board Certification process to effective teaching.

In conclusion, teacher quality will continue to be a policy target for policymakers seeking to increase the number of students who are college and career ready. Career and Technology Education in Oklahoma has largely embraced National Board Certification as the mechanism to increase teacher quality. As more teachers earn NBPTS certification, school districts will look to attract and retain NBCTs as effective strategies to improve teacher quality and instructional effectiveness. Findings from this study raise questions about the most effective ways to support teacher quality. Can teacher quality be improved in Career and Technical Education by incentivizing more teachers to earn NBCT or are other measures like fostering teacher learning communities or focused professional development necessary? While this research does not provide definitive answers it does point to the fact that the effects of NBCTs in Career and Technology Education are untested and require more research before making the NBPTS Certification process the keystone of teacher quality reform.

REFERENCES

Aaronson, D., Barrow, L., & Sander, W. (2007, January). Teachers and student achievement in the Chicago public high schools. *Journal of Labor Economics,* 95-135.

ACT . (2010, November 7). *ACT WorkKeys Overview.* Retrieved November 10, 2010, from ACT: http://www.act.org/workkeys/index.html

Anderson, R. N., Greene, M. L., & Loewen, P. S. (1988). Relationships among teachers' and students' thinking skills, sense of efficacy, and student achievement. *Alberta Journal of Educational Research*, 34(2) 148-165.

Angrist, J. D., & Lavy, V. (2001). Does teacher training affect pupil learning? Evidence from matched comparisons in Jerusalem public schools. *Journal of Labor Economics , 19* (2), 343–369.

Archer, J. (2002). Students' fortunes rest with assigned teacher. *Education Week , 17* (23), 3.

Aron, A., Aron, E. N., & Coups, E. J. (2008). *Statistics for the behavioral and social sciences: A brief course,* (4th ed.).Upper Saddle River, New Jersey: Pearson Prentice Hill.

Ballou, D. (2003). Certifying accomplished teachers: A critical look at the National Board for Professional Teaching Standards. *Peabody Journal of Education , 78* (4), 201–219.

Baratz-Snowden, J. (1993). Assessment of teachers: A view from the National Board for Professional Teaching Standards. *Theory into Practice , 2*.

Barfield, S. C., & McEnany, J. (2004). *Montana's national board certified teacher's views of the certification process.* Unpublished article, Montana State University at Billings.

Belden, N. (2002). *California teachers' perceptions of national board certification.* Santa Cruz, CA: Center for the Future of Teaching and Learning.

Benz, J. (2000). Looking for a few good teachers. *Independent School , 59* (3), 80–84.

Berg, J. H. (2003). *Improving the quality of teaching through National Board Certification: Theory and practice.* Norwood, MA: Christopher–Gordon Publishers, Inc.

Berliner, D. C. (2002). Educational research: The hardest science of all. *Educational Researcher , 31* (8), 18–20.

Berman, P., McLaughlin, M., Bass, G., Pauly, E., & Zellman, G. (1977). *Federal programs supporting educational change: Factors effecting implementation and continuation.* Santa Monica, CA: RAND

Berry, B., Johnson, D., & Montgomery, D. (2005). The power of teacher leadership. *Educational Leadership , 65* (5), 56–60.

Betts, J. R., Zau, A. C., & Rice, L. A. (2003). *Determinants of student achievement:New evidence from San Diego.* San Francisco: Public Policy Institue of California.

Bond, L., Jaeger, R., Smith, T., & Hattie, J. (2000). *The certification system of the National Board for Professional Teaching Standards: A construct and consequential validity study.* Greensboro, North Carolina: University of North Carolina.

Boyd, D., Grossman, P., Lankford, H., Loeb, S., & Wyckoff, J. (2006). How changes in entry requirements alter the teacher workforce and affect student achievement. *Education Finance and Quality , 1* (2), 176–216.

Boyer, E. L. (1983). *High school: A report on secondary education in America.* New York, NY: Harper and Row, Inc.

Bussato, S. (2004). What's making the difference in achieving outstanding primary school learning outcomes in numeracy? *Australian Primary Mathematics Classroom , 9* (4), 24–26.

Cantrell, S., Fullerton, J., Kane, T. J., & Staiger, D. O. (2007, April 16). *National board certification and teacher effectiveness: Evidence from a random assignment experiment.* Unpublished paper. A paper developed under a grant from the Spencer Foundation and the U.S. Department of Education.

Carnegie Forum on Education and the Economy. (1986). *A nation prepared: Teachers for the 21st century.* New York: Carnegie Forum on Education and the Economy.

Cavalluzzo, L. C. (2004). *Is National Board Certification an effective signal of teacher quality?* Alexandria, VA: CNA Corporation.

Chall, J. S., & Adams, M. J. (2000). *The academic acheivement challenge: What really works in the classroom?* New York: The Guildford Press.Chaplain, R., Miles, S. and Rudduck, J. (1994). *Disengagement and Male Underachievement: School Profiles Studies*. Homerton College, Cambridge

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2007). *How and why do teacher credentials matter for achievement?* Washington, D.C.: National Center for Analysis of Longitudinal Data in Education Research.

Cohen, C. E., & Rice, J. K. (2005). *National Board Certification as professional development: Design and cost.* Arlington, VA: National Board for Professional Teaching Standards.

Cohen, D. K., & Hill, H. C. (1998). *Instructional policy and classroom performance: The mathematics reform in California.* Philadelphia: Consortium for Policy Research in Education.

Conrad, C., & Serlin, R. C. (2005). *The Sage handbook for research in education: Engaging ideas and enriching inquiry.* Thousand Oaks, CA: SAGE.

Crawford, S., Hjelm, B., & Mohor, A. (2003). Will National Board Certification of physical educators improve the quality of teaching? *Journal of Physical Education, Recreation, and Dance, , 74* (2), 18–20.

Dagenhart, D. B. (2002). Comparing the wants and needs of National Board certified with non-National Board certified middle school teachers for personal job success and satisfaction. *Dissertation Abstracts International , 63* (11), 3836.

Darling–Hammond, L., & Youngs, P. (2002). Defining “highly qualified teachers”: "What does scientifically-based research” actually tell us? *Educational Researcher , 31* (9), 13-25.

Darling–Hammond, L., & Atkin, J. (2007). *Influences of National Board on teachers' classroom assessment practices.* Stanford University: Unpublished paper.

Dee, T. S. (2004). The race connection: Are teachers more effective with students who share their ethicity? *Education Next , 2*, 52–59.

DeLeon, A. G. (2003). After 20 years of educational reform, progress, but plenty of unfinished business. *Carnegie Results , 1* (3).

Dewey, J. (1900). *The school and society.* Chicago, Ill: The University of Chicago Press.

Eccles, J.S. and Blumenfield, P. Wilkinson, L. C. and Marrett, C. B. (eds) (1985). Classroom experiences and student gender: are there differences and do they matter? *Gender Influences in Classroom Interaction.* Academic Press, New York

Ellett, C. D., & Teddlie, C. (2003). Teacher evaluation, teacher effectiveness and school effectiveness: Perspectives from the USA. *Journal of Personnel Evaluation in Education; , 17* (1), 101—128.

Everhart, N., & Webb, T. P. (2004). The school library media specialist as a National Board Teacher Candidate in a low-performing school. *Knowledge Quest , 32* (3), 40–42.

Fenstermacher, G. D., & Richardson, V. (2005). On making determinations of quality in teaching. *Teachers College Record , 1*, 186–213.

Feuer, M. J., Towne, L., & Shavelson, R. J. (2002). Scientific culture and educational research. *Educational Researchers , 31* (8), 4–14.

Finn, C. E. (2003). High Hurdles. *Education Next* .3 (2), 62-67.

Fraenkel, J. R., & Wallen, N. E. (1996). *How to Design and Evaluate Research in Education.* New York: McGraw-Hill

Frechtling, J. A. (2007). *Logic modeling methods in program evaluation.* San Francisco: Jossey-Bass.

Frome, P., Lasater, B., & Cooney, S. (2005). *Well-qualified teachers and high-quality teaching: Are they the same?* Atlanta, GA: Southern Region Education Board.

Gardner, D. P. (1983). *A nation at risk: The imperarive for education reform. An open letter to the American people.* Washington, D.C.: National Commission on Excellence in Education.

Goals 2000 Partnership. (1996). *Goals 2000: A progress report.* Washington, D.C.:US Department of Education.

Goble, D. (2004). *Learning to earn: A history of career and technology education in Oklahoma.* Stillwater, OK: Oklahoma Department of Career and Technology Education.

Goddard, R. D., Hoy, W. K., & Hoy, A. W. (2000). Collective teacher efficacy: Its meaning, measure, and impact on student achievement. *Americal Educational Research Journal , 37* (2), 479–507.

Goe, L. (2007). *The link between teacher quality and student outcomes: A research sythesis.* Washington, D.C.: National Comprehensive Center for Teacher Quality.

Goe, L., & Stickler, L. M. (2008). *Teacher quality and student achievement: Making the most of recent research.* Washington, D.C.: National Comprehensive Center for Teacher Quality .

Goldhaber, D. D., & Brewer, D. J. (2000). Does teacher certification matter? High school teacher certification status and student achievement. *Education Evaluation and Policy Analysis* , 129–145.

Goldhaber, D., & Anthony, E. (2007). Can teacher quality be effectively assessed? National Board Certification as a signal of effective teaching. *Review of Economics and Statistics ,* 89 (1), 134–150.

Goodlad, J. I. (1984). *A place called school: Prospects for the future.* New York: McGraw Hill Book Co.

Gordon, D. T. (2002). Teaching as a profession. *Harvard Education Letter*. 23 (2), 23-28.

Gray, K. (1991). Vocational education in high school: A modern phoenix? *Phi Delta Kappan , 71* (6), 437–445.

Hanushek, E. A., & Jorgenson, D. W. (2006). *Improving America's schools: The role of incentives.* Washington, D.C.: National Academies Press.

Harman, A. E. (2001). *National Board for Professional Teaching Standards' National.* Washington, DC: ERIC Clearinghouse on Teaching and Teacher Education.

Harris, D. N., & Sass, T. R. (2009). The effects of NBPTS-certified teachers on student achievement. *Journal of Policy Analysis and Management , 28* (1), 55–80.

Harris, W. J., & Mackenzie, S. V. (2007). *National Board Teacher Certification in Maine: An exploratory study.* University of Maine, Orono: Maine Education Policy Research Institute.

Helms, R. G. (2001). NBPTS: The highest form of certification. *Kappa Delti Pi Record, 38* (1), 20–23.

Herschbach, D. R. (2001). The 1970's. *Journal of Industrial Teacher Education , 39* (1), 67-98

Hill, D. (1990). What has the 1980s reform movement accomplished? *Education Digest, 55* (6), 3–6.

Hill, H. C., Rowan, B., & Ball, L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal , 42* (2), 371–406.

Hoachlander, E. G., Kaufman, P., Levesque, K., & Houser, J. (1992). *Vocational Education in the United States: 1969–1990.* Washington, DC: U.S. Department of Education Office of Educational Research and Improvement.

Holland, R. (2002). *National teacher certification advancing quality or perpetuating mediocrity?* Alexandria, VA: Lexington Institute.

Honig, M. (2009). "What works in defining educational improvement. Lessons from educational policy", In Sykes, G.B., Schneider, B. and Plank, D. (Eds.), Handbook of Education Policy Research, Routledge, NY.

Hoy, W. K. (2007). *Quantitative research in education: A primer.* Ohio State University.

Humphrey, D. C., Koppich, J. E., & Hough, H. J. (2005). Sharing the wealth: National Board Certified Teachers and the students who need them most. *Education Policy Analysis Archives , 13* (18). Retrieved [June 17, 2009] from http://epaa.asu.edu/epaa/v13n18/.

Kannapel, P. J., & Clements, S. K. (2005). *Inside the black box of high-performing high-poverty schools.* Lexington, KY: Prichard Committee for Academic Excellence.

Kenney, C. (2008). *The best practice-how the new quality movement is transforming medicine.* New York: Public Affairs.

Koppich, J. E., Humphrey, D. C., & Hough, H. J. (2007). Making use of what teachers know and can do: Policy, practice, and National Board Certification. *Education Policy Analysis Archives , 15* (7). 75-82.

Krieg, J.M. (2005, April 12). Student Gender and Teacher Gender: What is the Impact on High Stakes Test Scores? *Current Issues in Education* [On-line], *8*(9). Available: http://cie.ed.asu.edu/volume8/number9/

Ladson–Billings, G., & Darling–Hammond, L. (2000). *The Validity of National Board for Professional Teaching Standards.* Washington, DC: National Partnership for Excellence and Accountabilty in Teaching.

Leatherwood, K. (2004). *The impact of NBCT on business education student outcomes.* Unpublished doctoral dissertation, Oklahoma State University, Stillwater.

Leedy, P. D., & Ormond, J. E. (2005). *Practical research: Planning and design* (8th ed.).. Upper Saddle River, New Jersey: Pearson Prentice Hall.

Linquanti, R., & Peterson, J. (2001). *An enormous untappedpotential: A study of the feasibility.* San Francisco: WestEd.

Lustick, D., & Sykes, G. (2006). National Board Certification as professional development:What are teachers learning? *Education Policy Analysis Archives , 14* (5). Retrieved [June, 17, 2009] from http://epaa.asu.edu/epaa/v14n5/. .

Manzo, K. (2004). Arizona sees benefits in National Board Certification. *Education Week , 24* (3), 12–21.

Mashburn, A. (2009, June 5). *Introduction to hierarchical linear modeling.* Charlottesville, VA: Center for Advanced Study for Teaching and Learning.

McLaughlin, M. & Talbert, J. (2006). *Building school-based teacher learning communities. Teachers* College. Columbia, Mo.

Midgley, D, Feldlaufer H., & Eccles J. S. (1989).Change in teacher efficacy and student self- and task-related beliefs during the transition from junior high to high school. *Journal of Educational Psychology*. 81 (2), 247-258.

Minner, S. (2001). Our own worst enemy. *Education Week*, *20* (38), 33.

Monk, D. H. (1994). Subject area preparation of secondary mathematics and science teachers and student achievement. *Economics of Education Review , 13* (2), 125–145.

Muijs, D. (2004). *Doing quantitative research in education with SPSS.* Thousand Oaks, CA: SAGE.

National Board for Professional Teaching Standards. (2009, August 1). Retrieved August 1, 2009, from National Board for Professional Teaching Standards: http://www.nbpts.org/about_us/mission_and_history/history

National Board for Professional Teaching Standards. (2009). *2009 Guide to National Board Certification.* San Antonio, TX: Pearson Education Inc.

National Board for Professional Teaching Standards. (2006). *Career and Technology Education Overview.* Retrieved August 25, 2009, from National Board for Professional Teaching Standards: www.nbpts.org/index.cfm?t=downloader.cfmandamp;id=599

National Board for Professional Teaching Standards. (2004). *Moving education forward through National Board Certification.* Arlington, VA: National Board for Professional Teaching Standards.

National Center for Education Statistics. (2000). *Vocational Education in the United States: Toward the year 2000.* Washington D.C.: US Department of Education Office of Research and Improvement.

Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis , 26* (3), 237–257.

Office of Post Secondary Education. (2002). *Meeting the highly qualified teachers' challenge. The Secretary's Fourth Annual Report on Teacher Quality.*. Washington, DC: US Department of Education.

Oklahoma Commission for Teacher Preparation. (2008, August 2). Retrieved August 2, 2008, from Oklahoma State Department of Education: http://sde.state.ok.us/Teacher/ProfStand/default.html

Oklahoma Department of Career and Technology Education. (2009). *Measuring up: Statewide system overview profile.* Stillwater, OK: Oklahoma Department of Career and Technology Education.

Oklahoma Department of Career and Technology Education. (2009, August 2). *CareerTech introduction*. Retrieved August 2, 2009, from OK CareerTech: http://www.okcareertech.org/whoweare/whowe.htm

Oklahoma Department of Career and Technology Education. (2006). *Major milestones in career tech.* Stillwater, OK: Oklahoma Department of Career and Technology Education Curriculum and Instructional Materials Center.

Oklahoma Department of Career and Technology Education. (2008). *Teachers Guidebook for Reporting Data.* Stillwater, Oklahoma: Oklahoma Department of Career and Technology Education.

Oklahoma State Department of Education. (2009, August 8). *Oklahoma State Department of Education*. Retrieved August 8, 2009, from Oklahoma State Department of Education.

O'Leary, Z. (2004). *The essential guide to doing research*. Thousand Oaks, CA: Sage.

Phillips, A. (2008). A comparison of National Board Certified Teachers with non-National Board Certified Teachers on student competency in high school physical education. *Physical Educator , 65* (3).

Podgursky, M. (2001, Summer). Defrocking the National Board. *Education Next*.

Pool, J., Ellett, C., Schiavone, S., & Carey–Lewis, C. (2001). How valid are the National Board of Professional Teaching Standards assessments for predicting the quality of actual classroom teaching and learning? Results of six mini case studies. *Journal of Personnel Evaluation in Education , 15* (1), 31-–48.

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods.* Thousand Oaks, CA: Sage.

Rice, J. K. (2003). *Teacher quality: Understanding the effectiveness of teacher attributes.* Washington, DC: Economic Policy Institute.

Rivkin, S. G., Hanushek, E. A., & Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica , 73* (2), 417–458.

Rockoff, J. E. (2004, May). The impact of individual teachers on student achievement. *American Economic Review Papers and Proceedings* , 247–252.

Rockoff, J. E., Kane, T. J., & Staiger, D. O. (2008). What does certification tell us about teacher effectiveness? Evidence from New York City. *Economics of Education Review , 27* (6), 615–631.

Ross, J. A. (1992). Teacher Efficacy and the Effects of Coaching on Student Achievement. *Canadian Journal of Education,* 17 (1), 51-65.

Rouse, W. A. (2008). National Board Certified teachers are making a difference in student achievement: Myth or fact? *Leadership and Policy in Schools , 7* (1), 64–86.

Rowan, B., Correnti, R., & Miller, R. (2002). What large-scale survey research tells us about teacher effects on student achievement: Insights from the prospects study of lementary schools. *Teachers College Record , 104* (8), 1525–1567.

Sanders, W. L., & Horn, S. P. (1998). Research findings from the Tennessee Value-Added Assessment System (TVAAS) database: Implications for educational evaluation and research. *Journal of Personnel Evaluation in Education, , 12* (3), 247–256.

Sanders, W. L., Ashton, J. J., & Wright, S. P. (2005). *Comparison of the effects of NBPTS certified teachers with other teachers on the rate of student academic progress.* Cary, NC: SAS Institute.

Schacter, J., & Thum, Y. M. (2004). Paying for high and low quality teaching. *Economics of Education Review , 23*, 411–430.

Schalock, D., Schalock, M., & Myton, D. (1998). Effectiveness – along with quality – should be the focus. *Phi Delta Kappan , 79* (6), 468–470.

Scheetz, N., & Martin, D. (Spring 2006). Teacher quality: A comparison of national board certified and non-certified teachers of deaf students. *American Annals of the Deaf , 151* (1), 71–87.

Sclafani, S. (2002). No child left behind. *Issues in Science and Technology, , 19* (2), 43–47.

Scott, J. L., & Sarkees-Wircenski, M. (2001). *Overview of career and Technology education.* Homewood, IL: American-Technical Publishers.

Shakowski, N. (1999). National Board Certification: Setting high standards for teaching, learning, and schools: An administrator's perspective. *Teaching and Change , 48* (5), 71–81.

Shulman, L. S. (2004). *The wisdom of practice : Essays on teaching, learning, and learning to teach.* San Francisco: Jossey-Bass.

Sizer, T. R. (1992). *Horace's compromise: The dilemma of the American high school.* Boston: Houghton Mifflin Co.

Smith, T. W., Gordon, B., Colby, S. A., & Wang, J. (2005). *An examination of the relationship between the depth of student learning and National Board Certification status.* Arlington, VA: National Board for Professional Teaching Standards.

Smylie, M. (2010). *Continuous school improvement*. Thousand Oaks, CA: Corwin.

Stone, J. E. (2002). *The value-added achievement gains of NBPTS-Certified teachers in Tennessee: A brief report.* Johnson City, TN: College of Education East Tennessee University.

Strauss, R. P., & Sawyer, E. A. (1986). Some new evidence on teacher and student competencies. *Economics of Education Review , 5* (1), 41–48.

Stronge, J. H., & Hindman, J. L. (2003). Hiring the best teachers. *Educational Leadership , 60* (8), 48–52.

Stronge, J. H., Ward, T. J., Tucker, P. D., & Hindman, J. L. (2007). What is the relationship between teacher quality and student achievement? An exploratory study. *Journal of Personnel Evaluation in Education , 20* (3–4), 165–184.

Summers, A. A., & Wolfe, B. L. (1977). Do schools make a difference? *American Economic Review , 67*, 639–652.

Sykes, G., Anagnostopoulos, D., Cannata, M., Chard, L., Frank, K., McCrory, R., et al. (2006). *National Board teachers as organizational resource.* Arlington, VA: National Board for Professional Teaching Standards.

Tate, R. L., & Pituch, K. A. (2007). Multivariate hierarchical linear modeling in randomized field experiments. *Journal of Experimental Education , 75* (4), 317–337.

The Future Of Children / Center For The Future Of Children. (2007 Spring). *The David And Lucile Packard Foundation [Future Child] , 17* (1), 45–68.

United States. (1983). *A nation at risk :The imperative for educational reform : A report to the Nation and the Secretary of Education, United States Department of Education.* Washington, D.C.: National Commission on Excellence in Education.

United States Department of Education. (2002). *Strategic Plan.* Washington, DC. Education Publication Center.

Vandevoort, L. G., Amrein-Beardsley, A., & Berliner, D. C. (2004). National Board Certified Teachers and their students' achievement. *Education Policy Analysis Archives , 12* (46), 1-117.

Wang, J. (1999). Reasons for hierarchical linear modeling: A reminder. *Journal of Experimental Education , 68* (1), 89–94.

Wayne, A. J., & Youngs, P. (2003). Teacher characteristics and student achievement gains: A review. *Review of Educational Research , 73* (1), 89–122.

Webb, T. (2010, January 21). *Tennessee value-added assessment system –TVAAS* Retrieved January 21, 2010, from Tennessee Department of Education: http://www.state.tn.us/education/assessment/test_results.shtml

Wenglinsky, H. (2002). How schools matter: The link between teacher classroom practices and student academic performance. *Education Policy Analysis Archives , 10* (12), 23-58.

Williams, L., and Rink, J. (2003). Chapter 1: Developing and implementing a state. *Journal of Teaching in Physical Education, , 22* (5), 473–493.

Xin, T., Xu, Z., & Tatsuoka, K. (2004). Linkage between teacher quality, student achievement, and cognitive skills: A rule space model. *Studies in Educational Evaluation , 4*, 205–223.

Yankelovich Partners. (2001). *Accomplished teachers taking on new leadership roles in schools: Survey reveals growing participation in efforts to improve teaching and learning* . Arlington, VA: National Board for Professional Teaching Standards.

Zeichner, K. M. (1991). Contradictions and tensions in the professionalization of teaching. *Teachers College Record , 92* (3), 363–379.

Zepeda, S. (2006). High stakes supervision: We must do more. *International Journal of Leadership in Education*, 9 (1), 61-73.

APPENDIX A

STUDENT LEVEL CODING

Student Achievement:

0 = Failed Exam

1 = Passed Exam

SES (Socio-Economic Status): Students who qualify for federal lunch subsidy.

0 = No

1 = Yes

Minority Status:

Minority (African American, Native American, Asian or

Hispanic) and Non-Minority (Caucasian)

0 = Non-Minority

1 = Non-Minority

APPENDIX B

TEACHER LEVEL CODING

National Board Certification:

0 = Non-NBCT

1 = NBCT

Educational Attainment: Degrees earned

0 = Bachelor's degree

1 = Master's degree and above

APPENDIX C

IRB EXPEMPT

LETTER

The University of Oklahoma

OFFICE FOR HUMAN RESEARCH PARTICIPANT PROTECTION

IRB Number: 12758
Category: 4
Approval Date: October 28, 2009

October 28, 2009

Tammie Carleon
Educational Leadership and Policy Studies
4502 East 41st Street, SCH-TUL
Tulsa, OK 74135

Dear Ms. Carleon:

RE: Oklahoma Career and Technology Education Teachers: The Effect of National Board for Professional Teaching Standards Certification on Student Achievement

On behalf of the Institutional Review Board (IRB), I have reviewed the above-referenced research project and determined that it meets the criteria in 45 CFR 46, as amended, for exemption from IRB review. You may proceed with the research as proposed. Please note that any changes in the protocol will need to be submitted to the IRB for review as changes could affect this determination of exempt status. Also note that you should notify the IRB office when this project is completed, so we can remove it from our files.

If you have any questions or need additional information, please do not hesitate to call the IRB office at (405) 325-8110 or send an email to irb@ou.edu.

Cordially,

Donald Baker, Ph.D.
Vice Chair, Institutional Review Board

Ltr_Prot_Exmpt_X

660 Parrington Oval, Suite 316 Norman, Oklahoma 73019-3085 PHONE: (405) 325-8110 FAX: (405) 325-2373