SCIENCE TEACHER EFFICACY, NATIONAL BOARD CERTIFICATION, AND OTHER TEACHER VARIABLES AS PREDICTORS OF OKLAHOMA STUDENTS' END-OF-INSTRUCTION (EOI) BIOLOGY I TEST SCORES

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CHAPTER I

INTRODUCTION

Concerns about the quality of America's education system and their concomitant reform efforts permeated the 20th century. With the dawn of the 21st century, the basis for these concerns has now broadened from the potential economic loss from decreased human productivity to include human safety and national security. As the *U.S. Commission on National Security in the Twenty-First Century* reports (2001),

> The inadequacies of our systems of research and education pose a greater threat to U.S. national security over the next quarter century than any potential conventional war that we might imagine. American national leadership must understand these deficiencies as threats to national security. If we do not invest heavily and wisely in rebuilding these two core strengths, America will be incapable of maintaining its global position long into the 21st century (p.9).

This statement was, in part, a response to the 1995, 1999, and 2003 Third International Mathematics and Science Study (TIMSS) reports by the National Center for Education Statistics (Gonzales, et al., 2004). Also supporting the U.S. Commission on National Security's firm stand on science education reform were the 2000 National Assessment of Educational Progress (NAEP) results. Both TIMSS and NAEP revealed that U.S. science and mathematics education reform efforts were not producing the expected increase in scientific knowledge among American children when compared to children from other countries or when measured against the *National Science Education Standards* (National Research Council, 1996). Thus, the level of scientific expertise required for U.S. global economic leadership and national security in the 21st century was being threatened by the low academic achievement of many U.S. children. Serving in the capacity of U.S. Secretary of Education, Rod Paige stated,

> We should think big thoughts and have high expectations. The American school system must become and remain the best in the world. We need all of our students to excel, not just some. President Bush wants to raise all schools to the highest levels of scholarship and motivation (U.S. Department of Education, 2004 (a), p.24).

A report from the Teaching Commission (2004) reported that raising student achievement directly leads to national economic growth and that quality teachers are requisite to high student achievement. Former chairman of IBM and chairman of the Teaching Commission, Louis Gerstner, Jr., stated,

> If we don't step up to the challenge of finding and supporting the best teachers, we'll undermine everything else we are trying to do to improve our schools. That's a conscious decision that would threaten our economic strength, political fabric, and stability as a nation (The Teaching Commission, 2004).

Raising educational expectations in America's schools and sustaining successful reforms requires the efforts of not only state education agencies and local school districts but also individual administrators and teachers as well. To expedite education reform, President Bush signed into action the No Child Left Behind Act (Public Law 107-110) in 2002. No Child Left Behind (NCLB) uses accountability as a crucial step in addressing the achievement gaps that exist among ethnic and socioeconomic groups. To narrow these gaps, by raising student test scores, every state is required to set standards for student performance for grade-level achievement and develop a system to measure the progress of all students and subgroups of students. Additionally, NCLB pledges to have a highly qualified teacher in every classroom by the end of the 2005-2006 school year (U.S. Department of Education, 2004). According to the U.S. Department of Education (2004) secondary school teachers are "highly qualified" if they, "(1) hold a bachelor's degree, (2) hold a certification or licensure to teach in the state of his/her employment, and (3) have proven knowledge of the subjects he/she teaches" (p.15). NCLB propounds that establishing state standards, that highly qualified teachers use as a guide, will ensure that all children – from every ethnic and cultural background – receive a quality education and the opportunity to realize their academic potential.

Background of the Study

According to Atkin and Black (2003) societal demands drive educational reform. In the pursuit of academic supremacy, the United States expects schools to reflect and transmit to all school age children the same values, morals, needs, and views that prevail in the nation at any given time. In the early 1900's a predominantly agricultural society relied on public education to prepare students to succeed on the farm. Disagreements over what science courses should be offered and how the courses should be taught in order to achieve optimal learning prevailed. A traditional curriculum emerged that consisted of science programs with textbooks, laboratory equipment, and assessment strategies designed to educate the farming society (Bybee, 1991).

The growth of an industrial society in the U.S. resulted in a great number of people leaving rural farming areas and moving to the nation's rapidly expanding cities where factory jobs offered more opportunities and financial stability. Science education evolved by incorporating into the curriculum what the new industrial society deemed important. John Dewey advocated the traditional curriculum be replaced by a varied curriculum based on the interests and needs of students in a way that made classroom learning student-driven, thereby meeting the needs and interests of the students rather than the teachers (Dewey, 1959; Oliver, Jackson, Chun, Kemp, Tippins, Leonard, et al., n.d., retrieved May 27, 2005). Thus, learning about crop yields, animal husbandry, and home economics shared space in the curriculum with facts about four-stroke-cycle gasoline engines, principles of refrigeration, and Bernoulli's Principle.

A science education milestone occurred on October 4, 1957, when the Soviet Union successfully launched Sputnik I. The world's first artificial satellite, about the size of a basketball and weighing 183 pounds, took about 98 minutes to orbit the Earth on its elliptical path (Garber, 2003). This launch ushered in new political, military, technological, and scientific developments; it also served as a catalyst to science education reforms that are still progressing today. This new reform called for implementing more rigorous science courses, lengthening school days and years, and increasing mandated testing. However, the publications of *A Nation at Risk* (National Commission on Excellence, 1983) and the *Third International Mathematics and Science Study* (U.S. Department of Education, 2003) revealed that U.S. science education reform efforts were not producing the expected increase in scientific knowledge. In the late 1980's and early 1990's, several frameworks for curriculum significantly influenced state and local reform of school science programs. Some of those frameworks, which involved collaborative efforts on behalf of hundreds of individuals and the National Research Council, included the American Association for the Advancement of Science (AAAS)

1989 report *Science for All Americans* (American Association for the Advancement of Science, 1989) and the subsequent publication of *Benchmarks for Scientific Literacy* (American Association for the Advancement of Science, Project 2061, 1993), as well as the *National Science Education Standards* (National Research Council, 1996) project.

As the education advisor to AAAS, F. James Rutherford founded Project 2061 to take a long-term, large-scale view of educational reform in science (AAAS, 2005). The primary goal of Project 2061 was to increase science learning among all students, not just the brightest students (AAAS, Project 2061, 1990). The reform of science education developed by Project 2061 was based on the goal of producing a scientifically literate populace, and recommendations were presented in the form of basic learning goals and reform tools (AAAS, Project 2061, 1990).

With scientific literacy as the goal, Project 2061's *Science for all Americans* presented the traditional topics covered in most school curricula (e.g., the structure of matter, the basic functions of cells, prevention of disease, etc.) using two different approaches. First, the boundaries between traditional subject-matter categories were softened, and connections were emphasized through the use of important conceptual themes, such as systems, evolution, cycles, and energy. Second, differences in the amount of detail that students were expected to learn was substantially less than in traditional science courses. Traditional science courses were viewed as textbook-driven, where large amounts of content were "covered" and numerous principles and concepts were memorized, a type of teaching described as "a mile wide and an inch deep." In contrast, a fundamental premise of Project 2061 was that "schools do not need to be asked to teach more and more content, but rather to focus on what is essential to science literacy and to teach it more effectively" (American Association for the Advancement of Science, 1990, p. xvi). Key concepts and thinking skills were emphasized instead of specialized vocabulary and memorized procedures (AAAS, 1990).

The term "scientific literacy" was first used by Paul DeHart Hurd of Stanford University in his 1958 article, "Scientific Literacy: Its Meaning for American Schools" (Hurd, 1998). Hurd defined scientific literacy as an understanding of science in relation to civic and social experiences, which is essential for participation in this science/technology-based democracy. Similarly, in *National Science Education Standards*, scientific literacy was defined as "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (National Research Council, 1996, p.22).

Project 2061 also released the document *Benchmarks for Scientific Literacy* (American Association for the Advancement of Science, Project 2061, 1993). Where *Science for all Americans* explained what all students should know and be able to do when they exited high school, *Benchmarks for Scientific Literacy* consisted of specific goals and objectives educators should use as tools in designing a curriculum that made sense to them and met the standards for science literacy in increasing understanding for grades K-2, 3-5, and 9-12 (American Association for the Advancement of Science, Project 2061, 1993).

The *National Science Education Standards* (National Research Council, 1996) described the vision of science education – that all students achieve understanding of important ideas about natural events and phenomena through inquiry. Ultimately, the

National Science Education Standards (*NSES*) were intended to serve as a responsible guide that placed scientific literacy for all children as the goal of science education. In terms of pedagogy, *NSES* emphasized that "learning science is something students do, not something that is done to them" (National Research Council, 1996, p. 20).

To ensure that all children had an opportunity to reach a level of proficiency in school, including scientific literacy, the No Child Left Behind Act of 2001(PL 1-7-110) has required that all teachers be "highly qualified." In addition, No Child Left Behind (NCLB) has attached the availability of certain federal monies to student achievement as an incentive for states to comply with NCLB. In short, states would be awarded federal money if they met the requirements of NCLB and could demonstrate an increase in student achievement. Additionally, states had to describe how they planned to close the achievement gap to make sure all students, including students who were disadvantaged or below academic proficiency, would meet these mandates (Committee on Education and the Workforce U.S. House of Representatives, 2004).

Even before NCLB required states to establish educational content and process standards for each grade level, the state of Oklahoma had taken steps in that direction. During the 1993-94 school year, guided by the *NSES*, the Oklahoma State Department of Education and committees of Oklahoma educators established the Priority Academic Study Skills (PASS) in several subject areas, including science. The PASS standards were academic skills and knowledge that public school students were expected to master at each grade level. The science PASS standards were later revised in 1999 and approved in 2000 by the state legislature.

Sandy Garrett, Oklahoma Superintendent of Education, advocated that success in teaching any subject required high expectations, rigorous curriculum standards, and instruction that made the content relevant to students' lives. To ensure that secondary educators were teaching to the high standards of the state-mandated core curriculum, the Oklahoma legislators mandated End-of-Instruction (EOI) tests, which students would take upon completion of each of four core secondary school courses: Biology I, Algebra I, English II, and U.S. History. The EOI exams were Criterion-Referenced Tests and were components of the Oklahoma School Testing Program (Oklahoma State Department of Education, 2005). The EOI test results were reported as falling into one of four achievement performance levels: advanced, satisfactory, limited knowledge, and unsatisfactory. The student performance levels of satisfactory and advanced indicated students were meeting or exceeding Oklahoma's state academic content standards; limited knowledge and unsatisfactory levels of achievement indicated the student did not meet the state content standards (U.S. Department of Education, 2004(b)). The percentage of students achieving satisfactory and advanced levels of performance on EOI tests were used to determine proficiency and were reported in the school's Adequate Yearly Progress (AYP) reports, a measure of year-to-year student achievement on state mandated tests.

The No Child Left Behind Act required schools to demonstrate evidence of adequate yearly progress toward meeting state learning standards for all groups of students. According to NCLB, states must develop target starting goals for adequate yearly progress, and each state must raise the bar in gradual increments so 100% of the students in the state are proficient on state assessments by the 2013-2014 school year

(U.S. Department of Education, 2003). Schools that fail to meet or exceed the annual measurable objective risk losing Federal Title I funding. End-of-Instruction scores for each high school are also placed into a formula used to calculate a school's "report card" which is used to evaluate a school's performance compared to other schools in the state of Oklahoma. Thus, the EOI tests may have significant consequences for the school as a whole if student scores fall below a state's academic level of proficiency.

As a part of Oklahoma's compliance with NCLB, the EOI Biology I test was used to provide evidence of Oklahoma students' level of proficiency at the end of instruction in Biology I. On the EOI Biology I test, students respond to a variety of items linked to both the process/inquiry standards and the content standards identified in the Biology I PASS standards. Student scores for each school are presented in terms of the percentage of students scoring at each of the performance levels outlined in state law (Title 70 O.S. 1210.508) (Oklahoma State Department of Education, n.d.): advanced, satisfactory, limited knowledge, unsatisfactory. A student's EOI Biology I score is recorded on his/her high school transcript.

Statement of the Problem

The United States expects all its children to receive a quality education from highly qualified teachers, thereby providing all children an opportunity to reach an established level of proficiency. The No Child Left Behind Act of 2001 defines a "highly qualified" teacher as a teacher who holds a minimum of a bachelor's degree, certification or licensure to teach in the state of his/her employment, and has proven knowledge of the subjects he/she teaches (U.S. Department of Education, 2004(a)). To meet these minimum standards of a “highly qualified” status, NCLB has allowed states control over setting the requirements for obtaining a bachelor’s degree and teaching certification or licensure and over developing and implementing subject knowledge tests.

In 1986, the Carnegie Task Force on Teaching as a Profession issued a report titled *A Nation Prepared: Teachers for the 21st Century* (Carnegie Task Force on Teaching as a Profession, 1986). Its leading recommendation called for the establishment of a National Board for Professional Teaching Standards (NBPTS). The National Board for Professional Teaching Standards (2001) “recognizes that teaching is at the heart of education and further, that the single most important action the nation can take to improve schools is to strengthen teaching” (p.v). The National Board’s mission was to advance the quality of teaching and learning by:

- “maintaining high and rigorous standards for what accomplished teachers should know and be able to do.
- providing a national voluntary system certifying teachers who meet these standards, and
- advocating related education reforms to integrate National Board Certification in American education and to capitalize on the expertise of National Board Certified Teachers” (National Board for Professional Teaching Standards, 2005 p. 2).

As a result, the National Board for Professional Teaching Standards (NBPTS) established high and rigorous standards of its own for what they refer to as an “accomplished” teacher. These standards were “grounded philosophically in the NBPTS policy statement *What Teachers Should Know and Be Able to Do*. The NBPTS identified five core propositions:

- Teachers are committed to students and their learning.
- Teachers know the subjects they teach and how to teach those subjects to students.
- Teachers are responsible for managing and monitoring students’ learning.
- Teachers think systematically about their practice and learn from experience.

● Teachers are members of learning communities" (NBPTS, 2001 p. v-vii).

While most teachers in the state of Oklahoma have achieved the status of "highly qualified" according to NCLB and rank tenth in the nation for percentage of teachers holding a national board certification, students of some teachers score higher on the state mandated EOI Biology I test than students of other teachers. Researchers have argued that teachers' attitudes and self-efficacy play a significant role in the actions taken in their classroom, the time spent on lesson preparation, and the implementation of innovative reform practices (Ashton & Webb, 1986; Gibson & Dembo, 1984). In addition, teacher efficacy (Allinder, 1995; Rubeck & Enochs, 1991) and attitudes (Koballa & Crawley, 1985) that high school science teachers develop about science are related to the achievements and attitudes of their students.

Researchers have emphasized that teachers are the single most important factor for increasing student achievement and for closing the achievement gap. At the same time TIMSS and NAEP results reveal that the U.S. science and mathematics education reform efforts are not producing the expected increase in scientific knowledge among American children (Calsyn, Gonzales & Frase, 1999). While the amount of research related to efficacy beliefs of teachers (more specifically elementary teachers) may be abundant, comparatively much less research focuses on efficacy beliefs of high school science teachers -- particularly high school biology teachers. In addition, there has been little research that describes the characteristics, attitudes, and beliefs of high school science teachers whose students achieve at or above the academic proficiency level compared to the characteristics, attitudes, and beliefs of science teachers whose students fail to achieve at a level of academic proficiency.

Theoretical Framework

Over the past twenty-five years, research suggests that teachers' sense of self-efficacy plays a powerful role in student academic achievement (Armor, Conroy-Oseguera, Cox, King, McDonnell, L.Pascal, et al., 1976; Allinder, 1995 and Ashton & Webb, 1986), as well as in teachers' receptiveness to implementing new instructional practices to better meet the needs of their students (Berman, P., & Mclaughlin, M., 1976; Guskey, 1988) and their commitment to teaching (Evans & Tribble, 1986). Within the context of teaching efficacy, two sets of beliefs are acknowledged -- personal teaching efficacy and general teaching efficacy or outcome expectancy (Ashton & Webb, 1986; Gibson & Dembo, 1984). Personal teaching efficacy reflects a teacher's confidence in his/her personal capabilities to successfully accomplish a specific teaching task in a particular context. In contrast, outcome expectancy is defined as the belief that skillful instruction can offset the effects of variables beyond the teacher's control, such as an impoverished home environment (Gibson & Dembo, 1984; Tschannen-Moran et al., 1998).

Differences in efficacy can be explained using Bandura's (1986, 1997) Social Cognitive Theory. Social Cognitive Theory views individuals as the product of a dynamic interplay of behavior, cognitive and other personal factors, and environmental influences through a process of reciprocal determinism. Through cognitive processes and life experiences, people develop a generalized expectancy about specific action-outcome contingencies. Bandura argued that human behavior is influenced by the individual's beliefs regarding two classes of expectations: outcome expectancy, an individual's estimate of the likely consequences of performing that task at the expected level of competence, and efficacy expectation, the personal conviction that one can successfully execute the behavior required to perform the task (Bandura, 1986).

A growing body of empirical evidence indicates teacher quality to be the most important schooling factor in predicting student achievement (Eide, Golhaber, & Brewer, 2004). Thus, teacher quality is being utilized as the infrastructure behind the anticipated success of the NCLB Act. While some research leans toward the idea of improving teacher quality to increase positive change in student achievement (Darling-Hammond, 1999; Goldhaber & Anthony, 2003), other research supports the idea of teaching efficacy as the critical avenue to improving student test scores (Armor et al, 1976; Ashton & Webb, 1986; Ramey-Gassert, Shroyer, & Staver, 1996). Teachers demonstrating a strong sense of efficacy invested more effort in teaching, the goals they set, and their level of aspiration (Tschannen-Moran & Woolfolk-Hoy, 2001). In addition, teachers with a strong sense of efficacy were more willing to try innovative ideas (Berman, McLaughlin, Bass, Pauly, & Zellman, 1977; Guskey, 1988), conduct a student-centered (as opposed to a teacher centered classroom) environment (Ramey-Gassert, Shroyer, & Staver, 1996), and demonstrate patience when working with students struggling with a concept (Ashton & Webb, 1986; Gibson & Dembo, 1984). While Bandura's Social Cognitive Theory and self-efficacy beliefs may lend themselves to the idealism of the highly qualified teacher described in NCLB, the teacher attributes that NCLB uses to define a highly qualified teacher – degree, certification, and proven knowledge -- differ from those that researchers of teaching efficacy use to identify an effective teacher.

Purpose of the Study

The purpose of this study was to compare teacher efficacy beliefs (personal science teaching efficacy and outcome expectancy) of Oklahoma Biology I teachers whose students mean scores on the Oklahoma School Testing Program's (OSTP) End-of-Instruction (EOI) Biology I test met or exceeded the state academic proficiency level to teacher efficacy beliefs of Oklahoma Biology I teachers whose students' mean scores on the EOI Biology I test fell below the state academic proficiency level. Additionally, this study was designed to determine if a difference existed in EOI Biology I test scores of students taught under the guidance of a national board certified teacher and EOI Biology I test scores of students whose teacher was not national board certified. Finally, this study was designed to determine if selected attributes of Oklahoma Biology I teachers were predictors of student EOI Biology I test scores. The following research questions were addressed:

1. Is there a significant difference between the Personal Science Teaching Efficacy (PSTE) of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) and the PSTE of Oklahoma Biology I teachers whose students' mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700)?
2. Is there a significant difference between the science teaching Outcome Expectancy (OE) of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test met or exceeded the level

of proficiency (advanced or satisfactory; 700 or above) and the OE of Oklahoma Biology I teachers whose students' mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory).

3. Is there a significant difference between the EOI Biology I test scores of biology students taught by a national board certified teacher and EOI Biology I test scores of biology students taught by a teacher without national board certification?
4. What relationships exist between teacher attributes (i.e., level of degree, years of teaching experience, membership in professional organizations, amount of professional development, level of teacher-direction used in the classroom, use of state or national science standards, class size, and location of school) and students' mean score on the Oklahoma EOI Biology I test?

The results of this research contribute to literature on science teacher efficacy and its relationship to student academic achievement as measured by the Oklahoma EOI Biology I test in accordance with the No Child Left Behind Act of 2001. Additionally, the results augment the current literature on science teachers' beliefs about science teaching and student learning.

Assumptions

1. It was assumed that each teacher responded honestly and thoughtfully to the Science Teaching Efficacy Beliefs Instrument and the Teacher Attribute Questionnaire.
2. Attempting to make the STEBI content specific for biology, teachers were asked to mentally replace the word science and in its place read the word biology each time the word appeared in the 25 STEBI items. Thus, it was assumed that each science teacher mentally substituted the word *biology* for *science* when completing the Science Teaching Efficacy Beliefs Instrument (STEBI).
3. It was assumed that the End-of-Instruction Biology I test is a valid and reliable measure of student achievement of the Oklahoma Priority Academic Students Skills (PASS) standards for Biology I.

Limitations

Although participation in this study was voluntary, questionnaires were sent to schools that employed only one teacher responsible for teaching biology and to schools that disaggregated student EOI Biology I test scores to report results by individual teachers. If the school was large enough to employ a number of biology teachers but did not identify the individual teacher on the student EOI Biology I answer key then those participants were not included in the data analysis. In addition, because this study focused on Oklahoma Biology teachers and student EOI scores, results may not be generalized beyond Biology teachers in the state of Oklahoma.

Definition of Terms

End of Instruction tests – Criterion-referenced tests, mandated by Oklahoma legislators, taken at the cessation of specific required middle school and high school courses.

High-stakes testing – "tests required by the individual state Departments of Education as mandated by the state legislatures"(DeVillier, P., 2003, p.2).

National Assessment of Educational Progress (NAEP) – assessments to measure student performance in reading, mathematics, science and writing (Creech, J., 2000).

National Board Certification – "offered on a voluntary basis, it complements, not replaces, state licensing. While state licensing systems set entry-level standards for beginning teachers, National Board Certification has established advanced standards for experienced teachers" (NBPTS, 2005, p.2).

Outcome expectancy – a person's belief in his/her ability to have a positive impact on student learning regardless of factors external to the teacher.

Personal science teaching efficacy – the belief that a teacher has the skills and abilities to effectively teach science.

Scientific literacy - "the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity" (National Research Council, 1996, p.22).

Self-efficacy beliefs – "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986).

Teacher efficacy – "the teacher's belief in his/her capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context" (Tschannen-Moran, M., Woolfolk Hoy, A., & Hoy, W., 1998, p.233).

Organization of the Study

This study is presented in five chapters. Chapter I provides an overview of the study including background information, a formal statement of the problems to be investigated, the purpose of the study, a discussion of the significance of this research, the assumptions and limitations of the study, and definitions of terms used in the study. Chapter II presents a review of the relevant literature and research that provides the theoretical framework and research foundation for the study. In this chapter, five sections address the literature which includes educational reform and high-stakes testing, Oklahoma's EOI Biology-I test, teacher quality, national board certification, and teaching efficacy. Chapter III describes the research design and methodology used in the study -- specifically information relating to the purpose, research hypotheses, participants, research design, instruments used, and data analyses. Chapter IV reports the results of the data analyses and answers the four research questions/hypotheses in the study. Chapter V presents the summary, conclusions, and recommendations for further research. The study concludes with a bibliography and appendixes.

CHAPTER II

REVIEW OF LITERATURE

With the growing national interest in educational accountability and improved student science achievement, it is important to understand relationships between teacher attributes and student achievement. Oklahoma policy makers, educational leaders, and community groups are searching for variables that can assist in predicting the levels of achievement on End-of-Instruction (EOI) Biology I tests in Oklahoma public schools. The purpose of this chapter is to review literature relevant to the examination of science teaching efficacy beliefs, teacher attributes, and student achievement. Much of this literature review focuses on efficacy issues unique to teachers. Several areas of research are relevant to this research. The following are addressed:

1. Education Reform and High-Stakes Testing
2. Oklahoma's End of Instruction Biology I Test
3. Teacher Quality
4. National Board Certification
5. Teaching Efficacy

Education Reform and High-Stakes Testing

Songwriters often put into lyrics the values, morals, and concerns of the public. In the 1989 Rhythm Nations CD, Janet Jackson quoted a phrase from the H.G. Wells 1922

Novel *The Outline of History* in her introduction to the song "The Knowledge." The phrase, "we are in a race between education and catastrophe" expressed concerns not just from the American public, but concerns that were felt all the way to the White House. Remarks made by former U.S. Secretary of Education Rod Paige to the American Association of Colleges for Teacher Education (AACTE) during the 2002 annual meeting in New York made reference to this same educational concern by stating that, "our education failures are considered by many to be a national security issue" (U.S. Department of Education, 2002). The need for educational reform in the United States has been acknowledged for over fifty years, yet structuring a reform effort that meets the financial, physical, and emotional needs of each state in the nation has, in the past, not been accomplished equitably.

Shortly after the May 17, 1954, U.S. Supreme Court decision in Brown vs. Board of Education, outlawing racial segregation in public schools, the federal government first attempted major public educational reform with the enactment of the Elementary and Secondary Education Act of 1965. Although the government funneled money into the education system, this financial augmentation was an incomplete solution to the problems plaguing low student achievement (U.S. Department of Education, 2004). On August 26, 1981, plethora of concerns over the condition of U.S. school children's academic achievement sparked (then) Secretary of Education T.H. Bell to create the National Commission on Excellence in Education. The role of the commission was to examine the quality of education in American schools. Eighteen months later, the National Commission on Excellence in Education issued the groundbreaking report, *A Nation at Risk* (1983). The report discussed that "our nation is at risk" due to the erosion of the educational foundations of our society brought on by the acceptance of “mediocrity” in four important aspects of the educational process: content, expectations, time, and teaching (National Commission on Excellence in Education, 1983). Four overarching recommendations were made by the National Commission related to these educational processes. First, the Commission recommended that high school curriculum change from a “homogenized”, “diluted,” and “diffused” content with no central purpose to a curriculum guided by structure and content that included a minimum of four years of English, mathematics, science, and social studies, one-half year of computer science, and with two years of a foreign language advised. Second, the Commission championed implementing rigorous and measurable standards and increasing the expectations of academic performance and student conduct. Recommendations were also fashioned to significantly increase the learning time in school by increasing the effectiveness of allocated time, requiring longer school days, or lengthening the school year. The fourth recommendation by the Commission centered on amending teacher quality in the classroom as well as teacher respect within society (National Commission on Excellence in Education, 1983).

As a response to *A Nation at Risk*, “policymakers in every state but Iowa developed educational standards, and every state but Nebraska implemented assessment policies” to monitor those standards (Amrein & Berliner, 2002, p.4). Despite the recommendations of the National Commission on Excellence in Education to increase student preparedness for increased academic achievement and the widespread state-level responses, national and international testing provided no evidence of the anticipated positive results. In fact, the 1995 Third International Mathematics and Science Study

(TIMSS) ranked the performance of American twelfth graders in general mathematics and science knowledge among the lowest of all participating countries (Calsyn, Gonzales, & Frase, 1999).

The National Assessment of Educational Progress (NAEP) also found similar results when U.S. children were compared against national standards. In 1998 the NAEP designed assessments to measure student performance in the content areas of reading, mathematics, science, and writing (Sheppard, 2002). The governing board of NAEP defined three levels of performance: “Basic”, “Proficient”, and “Advanced” (Creech, 2000). Students identified at the “basic” level have partially mastered the fundamental knowledge and skills for that grade level. Students at the “proficient” level have demonstrated competency of challenging subject matter. Students at the “advanced” level have shown superior performance at the grade level or subject area. The NAEP assessments are considered credible sources of information for the cross-state comparison of student achievement. The low test scores of American children garnered the attention of legislators not only at the local and state levels but also at the national level (Creech, 2000).

Signed by President Bush on January 8, 2002, the No Child Left Behind Act of 2001 (Public Law 107-110) amended Title I of the Elementary and Secondary Education Act of 1965 and the legislation authorizing NAEP. Unlike the voluntary recommendations of the National Commission on Excellence in Education, NCLB requires all states to participate in assessments conducted by NAEP as a condition to receiving federal Title I funds. The National Assessment of Educational Progress is then, in turn, governed by rigorous review of the National Assessment Governing Board (National Assessment Governing Board, 2002).

The No Child Left Behind Act (NCLB) ensures “accountability” and “flexibility” as well as increased federal support for education (U.S. Department of Education, Office of the Secretary, Office of Public Affairs, 2004). The terms “accountability” and “flexibility” in NCLB refer to the requirements mandated by each state to set its own standards for grade-level achievement. In addition, each state must develop a way to assess the progress of all students and subgroups of students in meeting those state determined grade-level standards (U.S. Department of Education, 2004). “Adequate yearly progress” (AYP) is a measure of year-to-year student achievement on statewide assessments meeting federal requirements. Each state is responsible for establishing their definition of adequate yearly progress. Under federal regulations, public schools failing to meet AYP for two consecutive years in the same subject are eligible for interventions, such as providing supplemental services to students or requiring reorganization of the school or district; these schools are placed in a “needs improvement status.” These low performing schools are also required to notify parents of its “needs improvement” status, provide parents with the option to transfer their children to a higher performing public school, and form coalitions with parents, teachers, and outside experts to develop a plan to raise student achievement (Oklahoma State Department of Education, 2004).

Unlike the federal government, many scholars did not see testing as a solution to the deficiencies of public education (Amrein & Berliner, 2003; Darling-Hammond, 1999; De Villier, 2003). While the federal government assumed that more pervasive high-stakes tests – tests with consequences linked to results – would improve student motivation and raise student achievement (Ediger, 2001), some researchers such as Amrein and Berliner (2003) and De Villier (2003) are concerned that an increase in student testing for the validation of academic achievement may actually decrease student motivation, thereby increasing the proportion of students who leave school early. Darling-Hammond (1999) reviewed student scores on the NAEP test and discovered that among the twelve highest-scoring states in eighth grade mathematics in 1996, none had mandatory statewide testing programs in place prior to the mid 1990's. This also held true for fourth grade mathematics where only two of the top twelve states had implemented statewide testing programs prior to 1995. By contrast, among the twelve lowest-scoring states, ten had extensive testing programs in place prior to 1990.

Olson (2002) reports that as consequences associated with high-stakes testing intensify, teachers are changing what and how they teach. Results from Olson's survey indicate that a higher percent of teachers in high-stakes states reported that instruction in tested areas had increased (Olson, 2002). Despite the discrepancy over how the research was statistically analyzed by Thompson (2002), Amrein and Berliner (2002) found either no effect or a negative effect on student achievement in the eighteen high-stakes testing states (when individual state test scores were compared to national standardized tests such as NAEP, ACT, and SAT scores). Amrein and Berliner (2002) support reports made by Olson (2002) in asserting that individual state scores are easily manipulated through test-preparation programs and a narrowing of curricular focus. An insignificant or negative correlation between state test scores and NAEP, ACT, and SAT scores demonstrates an inability of students to extrapolate the learning of test drills associated with state tests taking place in the classroom to another domain or context. Sheppard

(2002) states that to truly measure student achievement, no special “teaching-to-the-test” should take place -- only teaching to the content standards represented by the test. Sheppard also emphasized that focusing on the content standards and using a variety of teaching strategies to ensure that knowledge generalizes beyond test-like exercises will provide students with learning opportunities that extend beyond the classroom.

Oklahoma’s End of Instruction Biology I Test

Because “America’s schools are not producing the science excellence required for global economic leadership and homeland security”, No Child Left Behind required all states to measure student progress in science at least once in each of three grade spans (3-5, 6-9, 10-12) each year beginning in 2007 (U.S. Department of Education, 2005, p.1). As of January 2002, Oklahoma was one of forty-nine states to administer a standardized assessment or progress test to monitor student achievement (DeVillier, 2002). Because schools must demonstrate evidence of “adequate yearly progress” toward meeting state learning standards for students in science and because biology is required of all students in the state of Oklahoma, Oklahoma legislators mandated an Oklahoma School Testing Program’s (OSTP) End-of-Instruction (EOI) Criterion-Referenced test for students at the completion of Biology I. According to the Oklahoma State Department of Education (2005), the purpose of the EOI Biology I test was to measure Oklahoma students’ level of science proficiency, which included an understanding of both scientific methods and biological concepts. Other Oklahoma EOI tests included English II, U.S. History, and Algebra I.

The EOI Biology I test consists of 80 multiple choice questions that are linked to the Biology I process and content standards identified in the Oklahoma Priority Academic Student Skills. The Priority Academic Student Skills (PASS) were established during the 1993 – 1994 school year, with science standards revised in 2000. PASS are the set of academic skills and knowledge public school students are expected to master at each grade level. Student test scores are presented in terms of performance levels outlined in state law Title 70 O.S. § 1210.508: advanced (769-999), satisfactory (700-768), limited knowledge (663-699), and unsatisfactory (455-662), and recorded on the student's high school transcript.

Teacher Quality

Apart from class sizes, per pupil expenditures, and teacher salaries, researchers have established that teacher quality attributes (i.e., level of education and years of experience) are the primary school-related factors affecting student achievement (Darling-Hammond, 1999). Under the guidelines of NCLB, all teachers must be "highly qualified" by the end of the 2005-06 school year. Edie, et al. (2004) defines teacher quality as "a teacher's ability to produce growth in student achievement" (p.231). According to NCLB, a secondary school teacher is identified as "highly qualified" if he/she: a) holds a bachelor's degree, b) holds a certification or licensure to teach in the state of her employment, and c) has proven competent in the subject(s) he/she teaches (U.S. Department of Education, 2004). As mentioned above, the No Child Left Behind Act holds states accountable for meeting these expectations, while at the same time provides flexibility in how states achieve them (U.S. Department of Education, 2003).

Thus, each state is responsible for setting standards, not only for student performance but also for teacher quality.

Darling-Hammond (1999) defines teacher certification or licensing status as "a measure of teacher qualifications that combines aspects of knowledge about subject matter and about teaching and learning" (p.10). But despite substantial evidence that student learning depends significantly on what teachers know and can do, U.S. states differ greatly in the extent to which they invest in teacher preservice and inservice education programs. Some states require only a minor in the field(s) to be taught while other states require a major in each area; the required college course work in pedagogy varies from 18 to 40 credit hours, and student teaching varies between 8 and 18 weeks (Darling-Hammond, 1999; Goldhaber & Anthony, 2003). Although differences exist between colleges and universities in setting graduation expectations for their students, 49% - 60% of colleges providing teacher education programs are accredited by the National Council for the Accreditation of Teacher Education (NCATE) and must meet that accrediting agency's stringent requirements.

Regardless of whether a teacher has a minor or major in the teaching field, whether they have 18 or 40 credit hours of college classes in pedagogy, or whether they have completed 8 or 18 weeks of student teaching, the preservice teacher (after successfully completing an accredited teacher education program) qualifies to apply for a teaching license or certificate. Once a competency test is passed and a diploma is in hand, the preservice student is now considered a "highly qualified" teacher according to NCLB. However, research demonstrates that not all "highly qualified" teachers produce the same level of student achievement. Therefore, differences must exist even within the label of "highly qualified" (Koballa & Crawley, 1985; Gibson & Dembo, 1984; Guskey, 1988; Eide, Goldhaber, & Brewer, 2004; Darling-Hammond, 1999). Thus, while a teacher may be highly qualified, they may not be effective in producing increases in student learning.

Although the *Equality of Educational Opportunity* (the Coleman Report, 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, Campbell, Hobson, McPartland, Mood, Weinfeld, & York, 1966, p.325), numerous researchers have questioned these results. For example, researchers have concluded that a teacher's years of experience, college course work, level of motivation, attitudes and beliefs can all influence teacher effectiveness and student achievement (Darling-Hammond, 1999; Brophy & Good, 1974; Goldhaber & Anthony, 2003; Koballa & Crawley, 1985). Students who are assigned to several ineffective teachers (teachers whose students score below average on state or national tests) consecutively have significantly lower achievement and gains in academic achievement than students assigned to several highly effective teachers in sequence (Sanders & Rivers, 1996). Once a teacher acquires tenure status, it becomes very challenging to remove the teacher from the school system. This explains why Goldhaber (2002) emphasizes the tremendous responsibility that school districts accept when considering teacher employment and tenure. With the expectations and requirements of NCLB, it is more critical than ever for school systems to seriously examine the results of educational research to ensure and maintain high standards in teacher quality.

Researchers have shown that inexperienced teachers (those with fewer than three years of experience) are typically less effective in terms of student achievement, as measured my state and national test scores, than more experienced teachers (Darling-Hammond 1995; Golhaber, 2002; Okpala, Smith, Jones, & Ellis, 2000). Penick and Yager (1983) found that regardless of the years of experience, teachers with ongoing professional development and enthusiasm for learning enjoyed increased student achievement. Darling-Hammond (1995) provided similar findings, concluding that teachers with more teaching experience and more education may be more effective in the classroom because they can provide more real-world applications. However, if a teacher does not continue to grow academically and professionally, the benefits gained through experience appear to wane after about five years of teaching (Darling-Hammond, 1995).

Studies conducted by Goldhaber and Brewers (2000) and Eide, Goldhaber, & Brewer, (2004) indicate that students of teachers with advanced degrees do not show significant academic gains, except in the fields of mathematics and science. Goldhaber and Brewers (2000) found that students who had teachers with subject-related degrees in math and science performed better than students of teachers without subject training when students' tasks required problem-solving and applications of science knowledge. Darling-Hammond & Youngs (2002) concur that a strong content knowledge increases student achievement. However, what certified teachers learn about teaching (pedagogy) through methods courses also enhances their amassed gains from a strong subject matter background. Several studies reveal that, regardless of a teacher's subject area, a significant positive correlation exists between a teacher's verbal ability and student outcomes, resulting from the increased ability of the teacher to convey ideas in clear and concise ways (Goldhaber, 2002; Goldhaber & Anthony, 2003).

Porter and Brophy (1988) include motivation as an attribute of the effective teacher. They expound that the energy required to teach effectively exceeds what most would comprehend. Porter and Brophy (1988) continue by listing six essential elements of motivated, effective teaching. First, a teacher must be able to communicate expectations to students in a clear and consistent style. Second, effective teachers continuously monitor students and provide feedback. Third, effective teachers not only know their subject but also recognize that common misconceptions students bring to class often interfere with their learning. According to the National Board of Professional Teaching Standards, such an understanding is the joint product of wisdom about teaching, learning, students, and content (NBPTS, 2005). Fourth, effective teachers provide learning situations in which students are required to formulate problems, generate hypotheses, organize information, and solve problems -- as opposed to merely memorizing facts. Fifth, effective teachers take time for self-reflection and self-evaluation, increasing learning opportunities for future students (NBPTS, 2002). Finally, effective teachers accept responsibility for guiding student learning and behavior.

In an interview, Shaughnessy (2004) asked Anita Woolfolk-Hoy, to explain the key elements of effective teaching; Woolfolk-Hoy labeled many of the same teacher quality characteristics as Porter and Brophy. She expressed that it is not at all sufficient for teachers to just know their subject matter, but they must also know how to present it in a clear, caring, respectful manner so that all children feel respected and valued. Then, learning can take place. She continued by saying that effective teachers steer away from pedagogy that values memorization of facts, but instead center on cooperative learning where children are engaged in activities (Shaughnessy, 2004). Clearly, many researchers have identified characteristics of teacher quality not mentioned in NCLB. Thus, the definition of a "highly qualified teacher" in No Child Left Behind may have little connection to the definitive characteristics researchers have found to be related to student achievement. Even the National Board of Professional Teaching Standards identifies teachers with the six essential elements, listed by Porter and Brophy (1988), as the characteristics of an "accomplished" teacher which is synonymous to "highly qualified" (NBPTS, 2001).

National Board Certification

In 1986, the Carnegie Task Force on Teaching as a Profession issued the report, *A Nation Prepared: Teachers for the 21st Century*. Its predominant recommendation called for the establishment of a National Board for Professional Teaching Standards (NBPTS) (Carnegie Task Force on Teaching as a Profession, 1986). The National Board's mission was to advance the quality of teaching and learning by:

- maintaining high and rigorous standards for what accomplished teachers should know and be able to do
- providing a national voluntary system certifying teachers who meet these standards,
- advocating related education reforms to integrate National Board Certification in American education and to capitalize on the expertise of National Board Certified Teachers (NBPTS, 2005).

The National Board for Professional Teaching has become a voluntary certification system that serves to complement, not replace, state licensing.

Goldhaber and Anthony (2004) advocated that a growing body of research supported the NBPTS certification process, which involved a number of exercises designed to require "intensive self-reflection and analysis" of an applicant's teaching. The process can be viewed as an important vehicle for setting or raising high standards for classroom educators, for "professionalizing" teaching, and for encouraging positive education reforms overall – ultimately contributing to the goal of improving student achievement. Farrell (2005) supported the notion of national board certified teachers serving as mentors to other teachers (especially in low-achieving schools) since national board certified teachers had completed intense professional development training and were considered a symbol of professional teaching excellence.

While NCATE defines standards used to accredit teacher education programs and the Interstate New Teacher Assessment and Support Consortium (INTASC) defines standards for the preparation and licensure of new teachers, it is the NBPTS that has outlined and established advanced standards for what it believes experienced teachers should know and be able to do (Goldhaber & Anthony, 2003; NBPTS, 2005).

National board certification is a rigorous process. The "NBPTS assessments include having teachers construct a portfolio that represents an analysis of their classroom work and participate in exercises designed to tap the knowledge, skills, disposition, and professional judgment that distinguish their practice" (NBPTS, 2005, p.2). Teachers achieving National Board Certification are recognized by NBPTS as effectively demonstrating enhanced student learning, as well as a high level of knowledge, skills, abilities, and commitments reflected in the NBPTS five core propositions:

1. "*Teachers are committed to students and their learning*" (NBPTS, 2005 p.3). This proposition is founded on the belief that all students can learn. In pursuit of

ensuring an equitable education for all students, accomplished teachers adjust their practices according to individual differences.

2. "*Teachers know the subjects they teach and how to teach those subjects to students*" (NBPTS, 2005 p.3). This "pedagogical content knowledge" identifies appropriate ways to present the subject matter to students through analogies, metaphors, experiments, demonstrations, and illustrations while overcoming common misconceptions held by students.

3. "*Teachers are responsible for managing and monitoring student learning*" (NBPTS, 2005 p.3). Accomplished teachers accept a facilitator role to inspire critical thinking skills in their students through an experimental and problem-solving orientation.

4. "*Teachers think systematically about their practice and learn from experience*" (NBPTS, 2005 p.4). Accomplished teachers model the virtues they seek to inspire in students by being a lifelong learner and reflect on experiences.

5. "*Teachers are members of learning communities*" (NBPTS, 2005 p.4). Accomplished teachers possess the interpersonal skills necessary to work on teams and conduct duties, outside the direct instruction of students that contribute to the quality and operations of the school.

The NBPTS assess a teacher's performance based on a portfolio, which accounts for 60% of a teacher's score, and a content test, accounting for 40% of the total score. The portfolio assesses a teacher's performance in a wide range of classroom settings and affords teachers an opportunity to select examples of their practice that show how they embody the *Standards*. The portfolio is divided into four entries: Entry 1 is based on student work samples taken from a major scientific idea taught over time; Entry 2 is designed to assess a teacher's classroom practice during an active scientific inquiry and is captured on a 20-minute video; Entry 3 requires a 20-minute video designed to assess a teacher's ability to engage students in an interactive whole class discussion about a science concept; and Entry 4 affords teachers the opportunity to illustrate their partnerships with students' families and community, and demonstrate how their professional development aids in student achievement (National Board of Professional Teaching Standards, 2002).

According to Goldhaber and Anthony (2004), the overall NBPTS pass rate indicates that NBPTS certification appears to be more difficult than the standard licensure testing utilized in most certification tests. The rigorous, year-long assessment that measures not only a teacher's content knowledge, but also a teacher's pedagogical knowledge and commitment to the profession, serves as an impediment for some who attempt the process. Thus, many teachers choose to avoid the rigorous process all together (The Southeast Center for Teaching Quality, 2004). Some of the 32,000 teachers who have achieved National Board Certification have contributed to the research literature by demonstrating that students of national board certified teachers enjoy higher achievement scores and learning gains than students of non-certified teachers (Goldhaber & Anthony, 2004).

Goldhaber et al. (1999) estimated that only 3% of the contributions teachers made towards advancements in student achievement was explained by teacher credentials such as experience and degree level. The remaining 97% was associated with teacher qualities or behaviors that could not be isolated or identified. Researchers have repeatedly demonstrated that the belief a teacher has in his/her ability, and the extent to which a teacher accepts responsibility for what and how his/her students learn, may be used to explain the 97% of teacher quality that cannot be accounted for (Porter & Brophy, 1988). This belief and acceptance of responsibility are related to the construct teaching efficacy. Ashton & Webb (1986) found that teachers with a strong sense of efficacy were more likely to try innovative ideas to help their students learn, to spend more time working with students struggling with a concept, and to conduct a classroom that was less teacher centered.

Teaching Efficacy

Grounded in Rotter's Social Learning Theory and inspired by the article, *Generalized Expectancies for Internal Versus External Control of Reinforcement* (Rotter, 1966), teacher efficacy was first conceptualized by researchers at the Rand Corporation in two independent studies that produced powerful results. Two Likert-type items were used to measure the extent to which teachers believed the control of their reinforcement lay within themselves or in the environment:

> Rand Item #1. "When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment."
>
> Rand Item #2. "If I really try hard, I can get through to even the most difficult or unmotivated students" (Armor, Conroy-Oseguera, Cox, King, McDonnell, Pascal, Pauly, & Zellman, 1976).

Teachers who subscribed to the first Rand statement believed that environmental factors overpower a teacher's ability to have an impact on student learning, thereby indicating that reinforcement of their teaching efforts lay outside their control, or was external to them. Teachers agreeing with the second Rand statement expressed confidence in their ability to teach students regardless of environmental factors, thus indicating that reinforcement of their teaching efforts lay within the teacher's control, or was internal to them (Tschannen-Moran, Woolfolk Hoy, and Hoy, 1998).

Researchers at the Rand Corporation studied teachers' belief in their own capabilities related to success in teaching reading to minority students in an urban context in Los Angeles, California (Armor, et al. 1976). Armor and his colleagues reported that the greater a teacher's sense of efficacy, the more the students advanced in reading achievement. One year later, a second Rand Corporation evaluation study found teacher efficacy to be a strong predictor of the success in the continuation of federally-funded innovations after the end of the funding period (Berman & McLaughlin, 1977).

"Although the results of the two Rand studies spiked interest in the construct of teacher efficacy, researchers were concerned about the reliability of the two-item scale and attempted to develop longer more comprehensive measures" (Tschannen-Moran, 1998, p. 205). Under the theoretical framework of Rotter's social learning theory (1967) and Weiner's attribution theory (Weiner, 1980), Guskey (1981) developed a thirty item instrument that measured teachers' Responsibility for Student Achievement. Using a 100% distribution scale between two alternative explanations, the RSA measured how much the teacher assumed responsibility for student outcomes. Exploring Teacher Locus of Control (TLC), Rose and Medway (1981) developed a twenty-eight item instrument with a forced-choice format. Teachers were asked to assign responsibility for student successes or failures from two competing statements. Some of the items described situations in which factors contributing to a student's success were controlled by the teacher (internal), while the competing statements described situations in which factors were external to the teacher. The other half of the items described situations in which students failed, again attributing the outcome to factors that were either within the teacher's control (internal) or were not (external). Rose and Medway (1981) found that the TLC was a better predictor of teacher behaviors than Rotter's (1966) Internal-External scale. Also seeking to expand the reliability of the original Rand teacher efficacy studies, Ashton and her colleagues developed the Webb Efficacy Scale (Ashton, Olejnik, Crocker, McAuliff, 1982). This seven-item instrument forced participants to agree with one of two statements. The study concluded that teachers scoring higher on the Webb scale demonstrated fewer negative interactions in their teaching style with responses such as, "every child is reachable; it is a teacher's obligation to see to it that every child makes academic progress." Teachers scoring lower on the scale demonstrated more negative interactions with responses such as, "a teacher should not be expected to reach every child; some students are not going to make academic progress". However, none of the aforementioned instruments met with wide acceptance from researchers (Webb & Ashton, 1987).

A second theoretical strand of self-efficacy grew out of the work of Bandura's social cognitive theory. Social cognitive theory provides an approach to understanding human cognition, action, motivation, and emotion (Bandura, 1977, 1986, 1997). Contrary to Rotter's internal-external locus of control (which emphasizes the causal beliefs about the relationships between actions and outcomes without requiring any conscious involvement of the individual or self-efficacy), Bandura's social cognitive theory emphasizes self-efficacy and stems from the view of human agency in which individuals are agents proactively engaged in their own development and make things happen by their own actions (Rotter, 1966; Bandura, 1977). This approach lends support to the assumption that individuals are not passive bystanders but can actively shape their environment through self-reflection and self-regulation (Maddux, 1995).

Also contrary to Rotter's single dimension in her social learning theory, Bandura's social cognitive theory describes two dimensions of efficacy beliefs rather than the beliefs about action-outcome contingencies. These two dimensions, self-efficacy and outcome expectancy, are used to provide a complete predication of human behavior. Bandura defines perceived self-efficacy as "beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations" (1986, p.2). Often confused with self-esteem, self-efficacy is concerned with judgments of personal capabilities, where self-esteem is concerned with judgments of personal worth (Bandura, 1997). In addition, self-efficacy is task specific. For example, a high school teacher may feel very capable of teaching students to classify organisms based on morphological difference in biology, but less capable at teaching students how to calculate stoichiometry problems in chemistry. Therefore, an individual's sense of self-efficacy may vary dependant upon the task, while an individual's level of self-esteem is more consistent across tasks.

The second dimension of social cognitive theory is outcome expectancy. Outcome expectancy is defined as "a person's estimate that a given behavior will lead to certain outcomes" (Bandura, 1977, p.193). Stated another way, outcome expectancy is the conviction that one can positively influence the outcome of events. Tschannen-Moran et al (1998) explain teaching outcome expectancy is a gage of the potential of teachers in general to be successful in spite of various external constraints such as an unsupportive home environment or unmotivated students.

Social cognitive theory (Bandura, 1977, 1986, 1997) supports the idea that how people interpret their results alters their own behavior, personal factors (i.e. cognition, affect, and biological events), and environmental factors in a mutually interacting -- almost cyclic, web-like manner. The cyclic relationship is the foundation of Bandura's (1986) conception of triadic reciprocality, and according to Maddux (1995) is perhaps the most important conception of social cognitive theory. It is the triadic reciprocal relationship and interaction of the three components (personal, behavioral, and environmental) of Bandura's social cognitive theory that determines how the four sources of information (mastery experiences, vicarious experience, physiological and emotional arousal, and verbal persuasion) influences a person's sense of efficacy. Pajares states that this conception emphasizes that "cognition plays a critical role in people's capability to construct reality, self-regulate, encode information, and perform behaviors" (Pajares, 2002, p.1).

Bandura (1977, 1986, 1997) postulated the interaction of four sources that influence a person's sense of efficacy: mastery experiences, vicarious experience, physiological and emotional arousal, and verbal persuasion. According to Tschannen-Moran, et al. (1998) these four sources contribute to both the analysis and competence of the task but in different ways. The most powerful source influencing efficacy is mastery experiences. Mastery experiences occur when individuals perform a task or activity, analyze the results (using cognitive, behavioral, and self-regulatory tools), formulate interpretations, and then develop beliefs about their capabilities in subsequent tasks or activities (Bandura, 1977, 1986; Pajares, 2002). Outcomes interpreted as successful may raise beliefs in self-efficacy; those interpreted as failures may lower it.

A second source of information capable of influencing self-efficacy is vicarious experiences. Vicarious experiences are provided by social models. Modeling can be particularly relevant when the individual has had little prior experience. Bandura (1997) explains, "through their behavior and expressed ways of thinking, competent models transmit knowledge and teach observers effective skills and strategies for managing environmental demands" (p.3). When individuals observe models with similar characteristics to their own and succeed through high effort without adverse effects, it increases the observer's belief that he/she may also posses these capabilities to also succeed at the task or activity. The opposite is also true; observing models with similar attributes exert high effort and fail at a task can undermine the observer's beliefs about his/her own capability to succeed (Pajares, 2002).

A third source of information capable of swaying self-efficacy is physiological and emotional arousal. The level of arousal and the source of perceived control influences self-efficacy (Bandura, 1977). Pajares (2002) explains that people can gauge their level of confidence by the emotional state they experience as they conduct the task. For example, feelings of anxiety and stress may actually increase a person's sense of efficacy when associated with confidence in completing a task. But if anxiety and stress are high due to feelings of perceived incompetence or failure due to poor task performance or preparation, a person's sense of efficacy may wane. Attribution theory is used to explain sources of perceived control (Maddux, 1995). The attribution theory describes how individuals interpret events and how this relates to their thinking and behavior. Weiner (1980) identified four important factors affecting attributions for achievement: ability, effort, task difficulty, and luck. If success is attributed to controllable causes such as ability or effort, then self-efficacy is increased. But if success is attributed to luck or the ease of the task, then self-efficacy may not be enhanced (Bandura, 1993).

Verbal persuasion can also influence self-efficacy through pep talks, performance feedback, or general discourse. The effect verbal persuasion has on a person's sense of efficacy depends on the credibility, trustworthiness, and expertise of the persuader (Bandura, 1986). For example, a first year biology teacher's sense of efficacy may be strengthened more by receiving constructive feedback from the science department supervisor than from a parent of a student in her class, due to the professional credibility and expertise of the department supervisor.

Although all four sources of information are important in molding an individual's sense of efficacy, it is how the individual interprets this information that is the critical component of self-efficacy (Tschannen-Moran, 1998). The idea of reciprocal determinism suggests that personal factors (such as one's self-efficacy beliefs) affect behaviors and the interpretation of environmental cues (Bandura, 1986). For example, a teacher may believe she put much effort into a biology lesson, and presented the content with confidence, only to have her students score poorly on the unit test. The teacher may respond to poor student test scores with anger or with enhanced effort to raise student understanding. How the teacher responds to comments by parents, other teachers, and peers over the low test scores is delineated from environmental cues; meaning that the teacher's cognitive processing determines how the sources of information will be weighed and how they will influence the analysis of the task and her personal teaching competence (Tschannen-Moran, 1998).

Brouwers and Tomic (2003) identified three instrument designs to measure a teacher's sense of efficacy stemming from Bandura's social cognitive theory. First, the Ashton vignettes (Ashton, Buhr, and Crocker, 1984) consisted of fifty items that described problem situations a teacher might encounter. Teachers were asked to make judgments regarding the cause or causes involved in each vignette. Like the teacher efficacy instruments using Rotter's social learning theory as the theoretical foundation, the Ashton vignettes were not widely received (Tschannen-Moran, et al., 1998). Addressing the concern for more task specific and subject specific test items, Bandura (1997) developed a thirty item instrument with seven subscales to measure a teacher's sense of efficacy. Bandura (1997) pointed out that teachers perform a wide array of tasks and teach diverse subjects, thus a teacher's self-efficacy may vary from task to task and from one subject to the next. Bandura believed that seven subscales would address the lack of specificity in the efficacy instruments used to measure a teacher's sense of efficacy missing in other instruments. Guskey (1988), Bandura (1997), and Pajares (2002) cautioned that self-efficacy measurements must be situation specific.

The most frequently used instrument to assess teacher efficacy is Gibson and Dembo's (1984) Teacher Efficacy Scale (Tschannen-Moran, Hoy, & Hoy, 1998; Brouwers and Tomic, 2003). Originally a thirty-item instrument, the Teacher Efficacy Scale was reduced to sixteen items that loaded on one of two factors– personal teaching efficacy (PTE) and general teaching efficacy (GTE). Gibson and Dembo (1984) defined teacher efficacy as a multidimensional construct composed of two relatively independent dimensions: personal teaching efficacy and general teaching efficacy. Dembo and Gibson (1985) defined personal teaching efficacy as the "belief that she or he has the skills and abilities to bring about student learning" (p.175) and general teaching efficacy as the "belief that any teacher's ability to bring about change is limited by factors external to the teacher" (p.174). Both factors, PTE and GTE, corresponded to Bandura's two-component theoretical model of self-efficacy – self-efficacy and outcome expectancy, respectively (Gibson and Dembo, 1984). The two dimensions also correlated with the original Rand questions. Factor items that loaded on the general teaching efficacy test items correlated with the RAND 1 question, while factor items that loaded on the personal teaching efficacy test items correlated with the RAND 2 question (Tschannen-Moran, Hoy, & Hoy, 1998).

Self-efficacy beliefs were shown to be strong predictors of behavior, regulating self motivation through the choices made and the goals set (Woolfolk-Hoy, 2004; Pajares, 2002; Bandura, A. 1986). Teacher efficacy has been associated with behavioral differences between teachers that led to variations in instructional practices, student achievement, and attitudes towards students (Allinder, 1995; Armor et al. 1976; Ashton & Webb, 1986; Gibson & Dembo, 1984). Teachers displaying a high sense of teaching efficacy (as opposed to those with a low sense of efficacy), were characterized by: communicating high performance and academic expectations to students, criticizing students less often, spending more time in whole-group instruction (Ashton & Webb, 1986; Dembo & Gibson, 1985); persevering with low achieving students, exerting extra effort helping students to succeed (Allinder, 1995); emphasizing instruction and learning to students through clear expectations (Allinder, 1995; Ramey-Gassert, Shroyer, & Staver 1996); spending more time monitoring and checking seatwork, implementing new instructional practices (Guskey, 1988); leading students to correct responses through skilled questioning techniques (Dembo & Gibson, 1984); providing a humanistic orientation toward control and management in the classroom (Enoch, Scharmann, & Riggs, 1995); and maintaining an independent and professional behavior (Ashton & Webb, 1986).

Teachers with a low sense of efficacy demonstrated limited patience with students, thus they were more likely to criticize students when they made errors, get flustered by interruptions, provide answers to students or call on another student without allowing adequate student "wait time" or without providing probing questions when a student does not respond quickly or correctly (Allinder, 1995; Ashton & Webb, 1986; Dembo & Gibson, 1985); spend more time in small group instruction with limited monitoring within or between groups (Dembo & Gibson, 1985); lack enthusiasm for teaching (Ashton & Webb, 1986; Ramey-Gassert, Shroyer, Saver, 1996); use the textbook as the driving force behind their curriculum ((Enoch, Scharmann, & Riggs, 1995; Rubeck and Enochs, 1991; Guskey, 1984); provide a teacher-centered environment, and foster a negative attitude (Allinder, 1995; Ashton & Webb, 1986; Ramey-Gassert, Shroyer, Saver, 1996).

Teaching efficacy has been shown to be context and subject-matter specific (Gibson and Dembo, 1984). A teacher may feel competent in teaching one academic area or with one group of students but feel less competent in another academic area or with a different group of students (Tschannen-Moran et al. 1998). Incorporating specificity to teaching efficacy research, some researchers have modified the Teacher Efficacy Scale developed by Gibson and Dembo (1984), to investigate teachers' sense of efficacy within particular curriculum areas.

Stating that "a specific measure of science teaching efficacy beliefs should be a more accurate predictor of science teaching behavior and thus more beneficial to the change process necessary to improve students' science achievement" (p.627), Riggs and Enochs (1990) developed the Science Teaching Efficacy Belief Instrument (STEBI) which measured teacher efficacy in the context of science teaching and learning. Consistent with the theoretical framework of Bandura's self-efficacy theory as a situation-specific construct and the statistical significance of Gibson and Dembo (1984), Riggs and Enochs (1990) found two separate uncorrelated factors in their instrument which paralleled the Gibson and Dembo (1984) instrument for validity and reliability. Riggs and Enochs (1990) called one factor, Personal Science Teaching Efficacy (PSTE), which related to a teacher's belief that he or she had the ability to effectively perform science teaching behaviors (Finson, Riggs, Jesunathadas, 1999). The second factor was labeled Science Teaching Outcome Expectancy (STOE), and related to the teacher's belief in a student's ability to learn regardless of environmental constraints (Ramey-Gassert, Shroyer & Staver, 1996). Enochs et al. (1995) selected the STEBI, to determine the belief a teachers has in his/her ability to effectively teach science and bring about student learning, because of its predictive ability of human behavior "derived by independent and interdependent knowledge of both the self-efficacy and outcome expectancy variables" (p.67).

Studies have shown that science teachers with a low sense of efficacy rely more on science textbooks to guide their curriculum, presenting facts from an authoritative, custodial, or behaviorist orientation to maintain classroom control (Enoch, Scharmann, & Riggs, 1995; Rubeck and Enochs, 1991; Guskey, 1984). Rubeck and Enochs (1991) reported that teachers lacking sufficient content knowledge tended to have lower self-efficacy beliefs, than teachers with strong content knowledge backgrounds and were often considered less effective in producing high student achievement. Often their motivation to teach science or to meet state or national curriculum standards for student benefits was deficient (Ramey-Gassert, Shroyer, Saver, 1996). In contract, when teachers have high self-efficacy beliefs, their teaching tended to be characterized by providing a more humanistic orientation toward classroom control and management (Enoch, Scharmann, & Riggs, 1995). Because they felt confident in their ability to teach science, had a strong content knowledge background, and believed that their students could learn; these self-driven science teachers were more likely to implement new instructional practices (recommended by the *National Science Education Standards*), providing students with opportunities to actively participate with peers during student-driven, inquiry-based activities (Enochs, Scharmann, & Riggs, 1995; Guskey, 1988; Ramey-Gassert, Shroyer, Saver, 1996; Rubeck and Enochs, 1991).

Researchers in education have shown that self-efficacy is a consistent predictor of behavioral outcomes (Riggs & Enochs, 1990; Pajares, 2002); teaching science is no exception. Unless a teacher believes that his/her actions can produce the desired outcomes, there is little incentive to act or to persevere in the face of difficulties. Thus, the STEBI has been used as a tool to measure the beliefs teachers possess in their abilities to teach science. But, as Goldhaber and Anthony (2004) point out, "the attributes that actually make teachers successful in the classroom – enthusiasm and ability to convey knowledge – may not be strongly related to the teacher attributes typically measured in education productivity studies" (p.5) such as the STEBI.

Summary

As supported by scientific research, teacher quality is pivotal to improving student achievement. The No Child Left Behind Act, purportedly based on research, requires that all children in public school be taught under the guidance of a highly qualified teacher. To achieve the status of “highly qualified”, a secondary teacher must hold a bachelor’s degree, a certification or licensure to teach in the state of his employment, and have proven knowledge of the subject(s) he/she teaches (U.S. Department of Education, 2004). One teacher attribute that NCLB has failed to tag in defining a highly qualified teacher is a teacher’s sense of self-efficacy.

Research has demonstrated that teachers with a high sense of efficacy are more effective in creating and managing a learning environment (i.e. monitoring students’ understanding, setting clear expectations, and maintaining students’ on-task behavior) (Ashton & Webb, 1986; Dembo & Gibson, 1985); they are more willing to try innovative ideas in the classroom (Guskey, 1988); they also demonstrate more patience with students who struggle academically (Allinder, 1995) – teacher attributes that encourage student success in the classroom as demonstrated by increased student test scores (Darling-Hammond, 1998; Porter & Brophy, 1988). Many of the attributes identified in a teacher with a high sense of teaching efficacy are also apparent in the five core propositions of the National Board of Professional Teaching Standards. These include a commitment to student learning, the use of alternate pedagogy to meet student needs, the ability to exemplify qualities they seek to inspire in students, the competency to reflectively think, and dedication to life long learning (NBPTS, 2001).

Aside from a highly qualified teacher in every classroom by the end of the 2005-2006 school year, NCLB has also set up a system of accountability. This accountability system requires all states to show "adequate yearly progress"; this measures year-to-year student achievement on statewide assessments that meet federal requirements. To demonstrate adequate yearly progress in Oklahoma, students at the high school level must take four End-of-Instruction tests (English II, U.S. History, Algebra I, and Biology I), and although students may take each test two times, the highest score will appear on their high school transcript.

Exploring relationships between science teacher efficacy, student achievement, and teacher attributes enables professional development programs to better meet the needs of inservice science teachers, as well as aid teacher education programs to better prepare preservice science teachers for the changing teaching tasks that lie ahead.

CHAPTER III

METHODOLOGY

This chapter describes the research methodology utilized in this study. The first two sections state the overall purpose of the study and the four research questions that were examined. Subsequent sections provide details outlining the participants, the instructional setting, the instruments used for collecting relevant data, and the procedures followed to obtain and analyze the data collected.

Purpose of Study

The primary purpose of this study was to investigate the difference in personal science teacher efficacy and outcome expectancy of Oklahoma Biology I teachers whose students' mean scores on the Oklahoma School Testing Program's (OSTP) End-of-Instruction (EOI) Biology I test met or exceeded the state proficiency level compared to Biology I teachers whose students' mean score on the EOI Biology I test fell below the proficiency level. In addition, this study determined if a difference existed between EOI Biology I test scores of students taught under the guidance of a national board certified teacher and EOI Biology I test scores of students taught by teachers without national board certification. Finally, this study determined if certain attributes of Oklahoma Biology I teachers, whose students' mean EOI Biology I test scores met or exceeded the academic proficiency level, differed from Oklahoma Biology I teachers whose students' EOI Biology I scores fell below the academic proficiency level on EOI Biology I test scores.

The specific research questions that guided this study were:

1. Is there a significant difference in the personal science teaching efficacy of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) and the PSTE of Oklahoma Biology I teachers whose students' mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700)?
2. Is there a significant difference in the science teaching outcome expectancy of Oklahoma Biology teachers whose student's mean scores on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) and the OE of Oklahoma Biology I teachers whose student's mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700)?
3. Is there a significant difference in EOI Biology I test scores of biology students taught by a national board certified teacher compared to EOI Biology I test scores of biology students taught by a teacher not holding a national board certification?

4. What relationships exist between teacher or school attributes (i.e., level of degree, years of teaching experience, membership in professional organizations, amount of professional development, level of teacher-direction used in the classroom, and use of state or national science standards) and students' mean score on the Oklahoma EOI Biology I test?

Research Design

Before data were collected for this study, a proposal describing the purpose of the study was developed, four hypotheses were delineated, and steps were taken to ensure protection of human participants as required by the University's Institutional Review Board (Appendix A, approved September, 2005). A survey design (Creswell, 2003) was employed to collect quantitative data obtained from a Teacher Attribute Questionnaire and Science Teaching Efficacy Belief Instrument (STEBI). In addition, student End-of-Instruction Biology I test scores were obtained from the Oklahoma Department of Education. A survey design was selected to conduct this study since it provided a quantitative or numeric description of teacher and school attributes, as well as qualitative beliefs and opinions of high school science teachers who teach Biology I. Additionally, a survey design was selected for its convenience and its low cost in collecting data from a large number of science teachers throughout the state of Oklahoma. This study was conducted using a voluntary sample of the total population of biology teachers in the state of Oklahoma.

Quantitative Measures

Teacher Attribute Questionnaire: A four page questionnaire, including selected choice answers as well as open-ended responses, was designed to gather information about the teacher's personal background and academic background (i.e., age, gender, national certification status, and college degree), school demographics (i.e., school and class size, and school location), and teaching experience (i.e., professional affiliations, professional development involvement, pedagogy, and EOI preparation) (Appendix B). The information obtained from the teacher questionnaire was utilized to identify which teacher attributes were associated with high or low student EOI Biology I test scores. Seven hundred and fifty questionnaires were sent to Oklahoma Biology I teachers in the fall semester, after schools and teachers had the opportunity to establish the 2005-2006 school year.

Science Teaching Efficacy Belief Instrument (STEBI): Quantitative data was collected through the administration of the Science Teaching Efficacy Belief Instrument (Appendix C). Bandura (1986) described self-efficacy as a situation specific construct. Hence, it was important to select an instrument designed to predict science teaching efficacy and not merely generalized efficacy beliefs. Previously, Gibson and Dembo (1984) developed an instrument to measure efficacy in general or global terms. Riggs and Enochs (1990) developed the Science Teaching Efficacy Belief Instrument (STEBI) which contained two subscales: the "Personal Science Teaching Efficacy Belief" (PSTE) scale and the "Science Teaching Outcome Expectancy" (STOE or OE) scale. Riggs and Enochs (1990) reported an item analysis on both scales. Reliability analysis produced an alpha coefficient of 0.92 for the PSTE scale and an alpha coefficient of 0.77 for the STOE. This instrument was designed to specifically assess personal teaching efficacy and outcome expectancy beliefs of inservice science teachers.

The STEBI consisted of 25 items, 13 of which were designed to assess personal science teaching efficacy and 12 of which assessed science teaching outcome expectancy. High school Biology teachers were asked to compare their beliefs to each of the 25 science teaching self-efficacy or outcome expectancy items. The responses on the STEBI were scored on a 5-point Likert-scale format by assigning a five to positively phrased items receiving a "strongly agree" response; a score of four to an "agree"; a score of three to an "uncertain" response; a score of two to a "disagree" response, and a score of one to a "strongly disagree" response. Negatively-worded items were scored in the inverse direction with "strongly agree" receiving a score of one and "strongly disagree" receiving a score of five.

Two separate scale scores were recorded for each participant. The sum for questions 2, 3, 5, 6, 8, 12, 17, 18, 19, 21, 22, 23, and 24 examined the personal science teaching efficacy belief. In accordance with Bandura's (1977, 1997) self-efficacy theory, a high score on the personal science teaching efficacy belief subscale indicated that high school science teachers were highly confident about their ability to effectively teach science to all students. These teachers were also more likely to implement new teaching strategies (Guskey, 1988), encourage student centered classroom atmospheres (Guskey, 1984; Enoch, Scharmann, & Riggs, 1995), and work patiently with academically-challenged students (Allinder, 1995). Science teachers with low personal science teaching efficacy were more likely to become frustrated with students who experienced difficulty understanding science concepts and thus become critical of students when they made science concept errors (Ashton & Webb, 1986). These science teachers felt uncomfortable about their ability to teach science content and process skills through an inquiry methodology in accordance with the National Science Education Standards (NRC, 1996; Gibson & Dembo, 1984).

The sum for questions 1, 4, 7, 9, 10, 11, 13, 14, 15, 16, 20, and 25 examined the outcome expectancy of science teachers. Teaching outcome expectancy was defined as the belief that effective teaching would have a positive effect on student learning regardless of environmental factors (e.g., family background, IQ, and school conditions) (Tschannen-Moran & Hoy, 2001). Teachers who score high on the science teaching outcome expectancy subscale felt confident about their ability to positively influence students' science understanding, regardless of outside factors (Riggs & Enochs, 1990). On the other hand, science teachers who score low tended to perceive the students' external circumstances (i.e., unsupportive home environment, low grades, or lack of classroom supplies and lab equipment) as being serious obstacles to the student's science achievement (Guskey, 1988).

End-of-Instruction Biology I Instrument: The No Child Left Behind Act required all states to measure students' progress in science at least once in each of three grade spans (3-5, 6-9, 10-12) beginning in 2007 (U.S. Department of Education, 2005, p.1). Therefore, the Oklahoma legislators mandated an Oklahoma School Testing Program's End-of-Instruction (EOI) Criterion-Referenced test (OSTP/EOI) for students at the completion of Biology I. According to the Oklahoma State Department of Education (2005), the purpose of the EOI Biology I test was to measure Oklahoma students' level of science proficiency which consisted of an understanding of scientific methods, as well as biological concepts.

For schools with the traditional nine-month, two-semester course, students take the EOI Biology I test during a three-week period falling between the last two weeks of April and the first week of May. Student test results were sent to schools in August or September during the same calendar year.

End-of-Instruction Biology I test results for each teacher participating in this study were obtained from the Accountability and Assessment division of the Oklahoma State Department of Education (SDE) in Oklahoma City, Oklahoma. Once a teacher/participant returned the questionnaire and efficacy instrument, a formal open records request was sent to the Oklahoma State Department of Education, requesting the participating teacher's mean student EOI Biology I test scores for the 2004-2005 school year. The State Department of Education then sent a summary report for the district and individual school where that teacher instructed.

Data Analysis

As aforementioned earlier, this study consisted of quantitative data analyses. A brief description of how the data was analyzed follows:

Research Question #1. Is there a significant difference in the personal science teaching efficacy of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) and the PSTE of Oklahoma Biology I teachers whose students' mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700)?

Research Null Hypothesis #1. No statistically significant difference would exist in the personal science teaching efficacy of Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology I test met or exceeded the level of proficiency and the Oklahoma Biology I teachers whose students' mean score on the Oklahoma EOI Biology I test fell below the level of proficiency.

To address hypothesis #1, the personal teaching efficacy statements 2, 3, 5, 6, 8, 12, 17, 18, 19, 21, 22, 23, and 24 on the Science Teaching Efficacy Belief Instrument were examined. An independent-samples t-test with alpha set at 0.05 was used to determine if a statistically significant difference existed in the personal science teaching efficacy of Oklahoma Biology teachers whose student's mean score on the EOI Biology I test met or exceeded the level of proficiency and the Biology I teachers whose student's mean score on the EOI Biology I test fell below the level of proficiency.

Research Question #2. Is there a significant difference in the science teaching outcome expectancy of Oklahoma Biology teachers whose student's mean scores on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) and the OE of Oklahoma Biology I teachers whose student's mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700)?

Research Null Hypothesis #2. No statistically significant difference would exist in the science teaching outcome expectancy of Oklahoma Biology teachers whose students' mean score on the EOI Biology I test met or exceeded the level of proficiency and the Biology I teachers whose students' mean score on the EOI Biology-I test fell below the level of proficiency.

To address hypothesis #2, the science teaching outcome expectancy statements 1, 4, 7, 9, 10, 11, 13, 14, 15, 16, 20, and 25 on the Science Teaching Efficacy Belief Instrument were examined. An independent-samples t-test at a 0.05 alpha level of was used to determine if a statistically significant difference existed between the outcome expectancy of Oklahoma Biology teachers whose students' mean score on the EOI Biology I test met or exceeded the level of proficiency and Biology I teachers whose students' mean score on the EOI Biology I test fell below the level of proficiency.

Research Question #3. Is there a significant difference in EOI Biology I test scores of biology students taught by a national board certified teacher compared to EOI Biology I test scores of biology students taught by a teacher not holding a national board certification?

Research Null Hypothesis #3. No statistically significant difference would exist between the EOI Biology I test scores of biology students taught by a national board certified teacher and EOI Biology I test scores of biology students taught under the direction of a teacher not holding a national board certification.

To answer hypothesis #3, an independent-samples t-test at a 0.05 alpha level was utilized to determine if a statistically significant difference existed between the EOI Biology I test scores of biology students taught by a national board certified teacher and EOI Biology I test scores of biology students taught under the direction of a teacher not holding a national board certification.

Research Question #4. What relationships exist between teacher or school attributes (i.e., level of degree, years of teaching experience, membership in professional organizations, amount of professional development, level of teacher-direction used in the classroom, and use of state or national science standards) and students' mean score on the Oklahoma EOI Biology I test?

Research Null Hypothesis #4. No statistical significant relationships would exist between teacher or school attributes (i.e., level of degree, years of teaching experience, number of professional organizations, amount of professional development, level of inquiry used in the classroom, and use of state or national science standards) and students' mean score on the Oklahoma EOI Biology I test.

To address hypothesis #4, a multiple regression analysis set at an alpha level of 0.05 was used to identify any differences that existed between teacher or school attributes and students' mean score on the Oklahoma EOI Biology I test. A multiple regression analysis was used due to the model's ability to utilize two or more independent (predictor) variables and a dependent (criterion) variable.

Participants

The participants involved in this study were Oklahoma high school Biology teachers who taught Biology I during the 2004-2005 school year and continued to teach at the same school during this study.

Participants were invited to voluntarily participate in the study. Names of high school science teachers and schools were obtained from the Open-Records department at the Oklahoma State Department of Education. To ensure a high response rate from participants, Salant and Dillman (1994) suggested a four-phase administration process. The first mailing was sent to 750 Biology teachers during the second week in October of 2005; this contained a short notice informing teachers of the research study (Appendix

D). The second mailing, containing the teacher attribute questionnaire, the Science Teaching Efficacy Belief Instrument, an informed consent form (Appendix E), and a pre-addressed, stamped return envelope, was sent approximately 8 days later. The third mailing was sent 10 days after the second; this mailing consisted of a postcard thanking the teachers who had participated in the study and encouraging the teachers who had not yet returned their research packet to do so. Although Salant and Dillman (1994) suggested a fourth mail-out consisting of a personalized cover letter with a handwritten signature, questionnaire, efficacy instrument, informed consent, and preaddressed return envelope with postage to all non-responding participants to increase the participation response rate, the fourth mailing was not conducted due the high response rate of the original mailings.

Research packets were sent to schools that employed only one teacher responsible for teaching biology or to schools that had separated student EOI Biology I test scores by individual teachers. If the school was large enough to employ more than one biology teacher but did not identify the individual teacher on the student EOI Biology I answer key (e.g., put the testing coordinators name in lieu of individual classroom biology teacher's name), then those participants were not included in the data analysis.

Participants from this study were obtained from a population of Oklahoma Biology I teachers who voluntarily participated in and returned the Teacher Attribute Questionnaire, STEBI, and informed consent form. Seven hundred and fifty participant packages were mailed with 214 teachers responding. Not all of the participants were used in the study for four reasons: first, if forms were not filled out completely; second, if one or more forms were not returned; third, if the participating teacher was new to the district or school, and if EOI test scores could not be matched; or fourth, if the participating teacher did not teach a Biology I class the previous year. Information from 196 of the responding participants was used in this study; thus, over a 25% response rate from the total Oklahoma biology teacher population was used. Demographic information obtained from the Teacher Attribute Questionnaire is given in Table 1.

Table 1

Demographics of Oklahoma Biology I Teacher Participants (N=196)

Category	Number	Percent (%)
Gender		
Male	79	40.3%
Female	117	59.7%
Age		
25 or under	4	2.0%
26-30	25	12.8%
31-35	35	17.9%
36-40	18	9.2%
41-45	24	12.2%
46-50	32	16.3%
51-55	32	16.3%
56-60	17	8.7%
61 or above	9	4.6%
Interest in National Board Certification		
Holding a NBC	9	4.6%
Pursing NBC	6	3.1%
Thought of pursuing NBC	74	37.8%
No interest in pursuing NBC	107	54.6%
Degree		
Bachelors	129	65.8%
Masters	65	33.2%
Doctorate	2	1.0%
Certification		
Traditional	167	85.2%
Alternative	29	14.8%

School Location (community size)		
Rural < 10,000	120	61.2%
Suburban	53	27.0%
Urban >100,000	23	11.7%

Student Class Size		
5-10	7	3.6%
11-15	21	10.7%
16-20	53	27.0%
21-25	69	35.2%
26-30	40	20.4%
31-35	4	2.0%
Above 36	2	1.0%

Frequency of NSES Usage		
Never	58	29.6%
Seldom	84	42.9%
Often	54	27.6%

Frequency of OK PASS Usage		
Never	6	3.1%
Seldom	20	10.2%
Often	170	86.7%

Teach AP Biology		
No	166	84.7%
Yes	30	15.3%

Classroom Environment		
1.0 Student driven	4	2.0%
2.0	7	3.6%
3.0	43	21.9%
4.0	64	32.6%
5.0 Teacher driven	78	39.8%

Preparedness		
No	60	30.6%
Yes	136	69.4%

Use of SDE Test Preparation Material		
No	19	9.7%
Yes	177	90.3%

Use of Alternative Test Preparation Material		
No	51	26.0%
Yes	145	74.0%

Research questions #1 and #2, divided Biology I teachers into two groups:

1. Proficient Group – The 41 Oklahoma Biology I teachers whose students' mean scores on the Oklahoma EOI Biology I test met or exceeded the level of academic proficiency (advanced or satisfactory; 700 or above).
2. Nonproficient Group – The 155 Oklahoma Biology I teachers whose students' mean scores on the Oklahoma Biology I test fell below the level of academic proficiency (Limited knowledge or unsatisfactory; below 700).

Research question #3 divided teachers into two groups:

1. National board certified teachers (9).
2. Non-national board certified teachers (187).

Ethical Considerations

Through the use of pseudonyms and assigned numbers for all participants, the privacy and confidentiality of participants was protected; written assurance of privacy and confidentiality was presented to each participant. In addition, all participant information was stored in a locked file cabinet to ensure continued privacy. Upon completion of the research project, all participant information was shredded.

The results of the data analysis are presented in Chapter IV with a discussion of the findings following in Chapter V.

CHAPTER IV

FINDINGS

The purpose of this study was to investigate the difference in personal science teacher efficacy and outcome expectancy of Oklahoma Biology I teachers whose students' mean scores on the Oklahoma School Testing Program's (OSTP) End-of-Instruction (EOI) Biology I test met or exceeded the state proficiency level compared to Biology I teachers whose students' mean scores on the EOI Biology I test fell below the level of proficiency. In addition, this study was designed to determine if a difference existed between EOI Biology I test scores of students taught under the guidance of a national board certified teacher and EOI Biology I test scores of students whose teacher did not hold a national board certification. And finally, this study was designed to determine if specific attributes of Oklahoma Biology I teachers as predictors of student EOI Biology scores that met or exceeded the state proficiency level.

In this chapter quantitative research data from 196 Biology I teachers across the state of Oklahoma will be presented from a Science Teacher Efficacy Belief Instrument and a Teacher Attribute Questionnaire.

The specific research questions that guided this study were as follows:

1. Is there a significant difference between the personal science teaching efficacy of Oklahoma Biology teachers whose students' mean scores

on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) and the PSTE of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700)?

2. Is there a significant difference between the outcome expectancy (OE) of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) and the OE of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700).
3. Is there a significant difference between the EOI Biology I test scores of biology students taught by a national board certified teacher and EOI Biology I test scores of biology students taught by a teacher not holding a national board certification?
4. What relationships exist between teacher attributes (i.e., level of degree, years of teaching experience, membership in professional organizations, amount of professional development, level of teacher-direction used in the classroom, use of state or national science standards, class size, and location of school) and students' mean score on the Oklahoma EOI Biology I test?

The theoretical framework as presented in Chapter II includes teacher efficacy and the two constructs of teacher efficacy, personal teaching efficacy and outcome expectancy. Chapter II included components of efficacy focusing uniquely on those beliefs that were frequently associated with inservice teachers at the secondary level. In chapter III, reference was made to the science teaching efficacy statements included within the Science Teaching Efficacy Belief Instrument (STEBI) through which participants rated their level of personal science teaching efficacy and outcome expectancy. Data were also collected through a Teacher Attribute Questionnaire which included selected choice answers as well as open-ended responses.

The findings discussed in Chapter IV include differences in beliefs relating to personal teaching efficacy and outcome expectancy, of Biology teachers whose students' mean score on the EOI Biology I test met or exceeded the Oklahoma state proficiency level (700 or above) and Biology teachers whose students' mean score on the EOI Biology I test fell below the state proficiency level (below 700). This chapter discusses the difference in EOI biology I test scores of students taught under the guidance of a national board certified teacher and teachers not holding a national board certification. Additionally, this chapter determines the relationships that exist between high EOI Biology I test scores and teacher attributes/characteristics.

Examining Self-Efficacy and Outcome Expectancy Beliefs

The constructs of personal science teaching efficacy beliefs and outcome expectancy beliefs of secondary Biology teachers, teaching certification, and End-of-Instruction Biology I test scores were the focus of this study. Oklahoma Biology teachers were asked to complete a survey investigating the two constructs so described. The responses on the Science Teaching Efficacy Belief Instrument (STEBI) were scored on a 5-point Likert scale from strongly agree (5) to strongly disagree (1). Negatively worded items were recoded for the analysis. The relationships between the beliefs of teachers with mean student EOI Biology test scores at or above 700 were examined against those of teachers with mean student EOI Biology test scores below 700. The analysis was computed using SPSS 11.0 statistical package (SPSS, 2001).

Since teachers were asked to mentally substitute the word biology for science on the STEBI, reliability was determined for the two constructs of science teaching efficacy. As annotated in chapter III, the mental substitution of the word biology for science may have had some influence on the reliability of the responses. Personal Science Teaching Efficacy reliability of the data on this instrument for all 196 participants was 0.77, and the Outcome Expectancy reliability for all 196 participants was determined to be 0.57; when question "7" was removed the OE reliability was determined to be 0.67. The data was presumed to be moderately reliable and generally consistent with the research study of Riggs and Enochs (1990).

TABLE 2

Item Correlations and Factor Loadings

Measure	Item	Pos-Neg Wording	Factor Loading #1	Factor Loading #2
	Item 2	P	.33	.31
	Item 3	N	.44	.07
	Item 5	P	.44	.05
Personal Science Teaching Efficacy Scale	Item 6	N	.36	.03
	Item 8	N	.25	.05
	Item 12	P	.49	.02
	Item 17	N	.64	.16
	Item 18	P	.63	.22
	Item 19	N	.74	.09
	Item 21	N	.40	.06
	Item 22	N	.71	.10
	Item 23	P	.64	.13
	Item 24	N	.52	.13
Total Scale Alpha = .77				
	Item 1	P	.33	.30
	Item 4	P	.06	.57
	Item 7	P	.06	.53
Science Teaching Outcome Expectancy Scale	Item 9	P	.03	.31
	Item 10	N	.14	.34
	Item 11	P	.16	.36
	Item 13	N	.05	.43
	Item 14	P	.09	.59
	Item 15	P	.14	.71
	Item 16	P	.23	.44
	Item 20	N	.01	.53
	Item 25	N	.02	.51
Total Scale Alpha = .57; .67 with Item #7 removed				

Factor analysis of the 25 items in the Science Teaching Efficacy Belief Instrument initially called for all available factors, resulting in five. However, the intercorrelations (listed in Table 2) from the item analysis revealed two distinct groups of items, thereby supporting the findings of Riggs and Enochs (1990) for two primary factors or dimensions in the STEBI. Items loading on factor one correlated with personal science teaching efficacy beliefs, while items loading on factor two correlated with science teaching outcome expectancy beliefs. The two factors did not correlate with each other, indicating homogeneity within and distinctiveness between the two groups.

The constructs of Personal Science Teaching Efficacy (PSTE) and Outcome Expectancy (OE) were further investigated through the responses provided by 196 Biology teachers on a Teacher Attribute Questionnaire. The questionnaire included twenty-nine limited response questions. Of the 29 limited response questions, seven queried further with open-ended explanations of the selected response.

Data Analyses

In conjunction with the mean End-of-Instruction Biology I test scores obtained from the Oklahoma State Department of Education (SDE) -- Open Records division -- for each of the 196 participants in this study, the Science Teachers Efficacy Belief Instrument data results were used to answer the first two research questions. Descriptive statistics and independent-samples t-tests were used to examine the mean scores in order to determine if significant differences existed in PSTE and OE of teachers whose mean student EOI Biology I test score met or exceeded the state proficiency level, and teachers whose mean student score fell below the proficiency level. The third research question was examined by using student EOI biology I scores obtained from the State Department of Education (SDE) to determine if there were any differences in student EOI Biology I scores of national board certified teachers and non-nationally certified teachers. The fourth research question/hypothesis examined responses from the Teacher Attribute Questionnaire that could be used as predictors of high student EOI Biology I scores.

Research Question 1

Quantitative Results from Research Question 1: The first question explored the differences in the personal science teaching efficacy, the teachers' belief in their ability to teach science, of Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology-I test met or exceeded the level of proficiency (700 and above) – Proficient group - and the Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology I test fell below the level of proficiency (below 700) – Non-proficient group. The 13 Personal Science Teaching Efficacy (PSTE) subscale items were analyzed for the purpose of making group comparisons. One hundred ninety-six Oklahoma Biology teachers responded to the 13 PSTE items that comprised one of the two subscales on the Science Teaching Efficacy Belief Instrument (STEBI). Descriptive statistics reporting the mean and standard deviation of each EOI Group are given in Table 3.

TABLE 3

Means, Standard Deviations, and Results of the Independent Sample T-Test for the Personal Science Teaching Efficacy and EOI Teacher Division Groups (N=196)

EOI Group	Mean	Standard Deviation
Non-Proficient	55.68	5.511
Proficient	55.59	4.533

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference		t (194)	p
		Lower	Upper		
.09	.935	-1.752	1.936	.098	.922

With a potential range in scores on the PSTE subscale of the Science Teaching Efficacy Belief Instrument from 13 to 65, the Proficient-Group teachers reported the same mean PSTE score, 55, as the Non-proficient-Group teachers. However, the Proficient-Group teachers had a smaller standard deviation, 4.533, indicating that the Proficient- Group teachers had less variance in their responses. After noting these descriptive differences, an independent-samples t-test was used to determine if the mean difference was statistically significant. The 95% confidence interval was calculated for the mean comparison. The result of the t-test is given in Table 3. The mean difference on the PSTE subscale scores between Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology-I test met or exceeded the level of proficiency (700 and above) -- the Proficient Group -- and the Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology I test fell below the level of proficiency (below 700) -- Non-proficient Group -- was not statistically significant [t (194) = .098, p = .922]. This indicates that personal science teaching efficacy was not statistically related to how a teacher's students scored on the EOI Biology I test.

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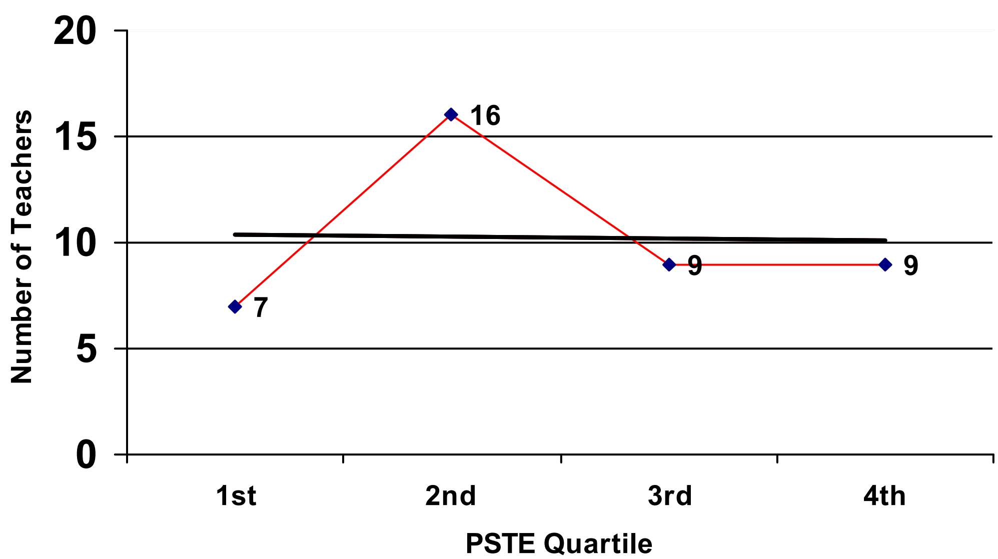
Figure 1. Number of Teachers with Average EOI Scores at or Above 700 by PSTE Quartile



To gain a deeper understanding as to why no significant difference in PSTE existed between the proficient group and non-proficient group of teachers, the 196 PSTE scores were arranged from greatest to least and then separated into four quartiles of 49 scores each. In Figure 1 the 1st quartile represents the 49 participants with the highest PSTE scores, while the 4th quartile represents the 49 participants with the lowest PSTE scores. Seven teachers in the 1st quartile had mean student EOI Biology I scores at or above 700 (the state proficiency level for Biology I), sixteen teachers in the 2nd quartile, nine in the 3rd quartile and nine in the 4th quartile had EOI scores 700 or greater. A

Pearson correlation coefficient measure was calculated between the number of teachers with mean student EOI Biology I scores at or above 700 and the quartile number where the corresponding teacher's PSTE score fell. An r-value of .033 was calculated. Due to the low r-value between the quartile numbers and the number of teachers who had mean student scores who met or exceeded the state academic proficiency level on the EOI Biology I test, the assumption was made that the variables were not bivariately normally distributed, meaning that the scores of one variable (number of teachers with average student EOI scores at or above 700) were independent of the scores on the second variable (the quartile number where the corresponding teachers PSTE score fell). To further measure the strength of the relationship between the two variables the correlation value was squared providing an r^2 value of .0011, thus concluding that only .1 percent of the variance of the EOI score was accounted for by Oklahoma Biology teachers' PSTE score.

These findings support the conclusion to accept research hypothesis #1; there was no statistical difference in the PSTE, the belief that teachers can effectively teach science, in biology teachers whose students' mean EOI Biology I test scores met or exceeded the state proficiency level, and Biology teachers whose students' mean EOI Biology I scores fell below the state proficiency level. The two groups have similar beliefs about their effectiveness to teach science.

Data obtained from the Teacher Attribute Questionnaire was utilized to gain a deeper understanding of the personal science teaching efficacy of Oklahoma Biology teachers. The Pearson Product Moment Correlation Coefficient was utilized to evaluate the statistical relationship between Biology teachers' PSTE and the age of the teacher.

Additionally, the Pearson Product Moment Correlation Coefficient was utilized to evaluate the statistical relationship between Biology teachers' PSTE and the level of college degree obtained. Table 4 shows that a positive correlation existed, at the 95% level of confidence with alpha set at .05, between the PSTE score of Oklahoma Biology teachers and the age of teachers. Table 4 also shows that a positive correlation existed, at the 99% level of confidence with alpha set at .01, between the PSTE score of Biology teachers and the level of college degree obtained.

TABLE 4

Results of the Pearson Product Moment Correlation Coefficient

for Relationships between PSTE and Age and College Degree (N = 196)

		PSTE
AGE	Pearson Correlation	*.167
	Sig. (2-tailed)	.019
	N	196
DEGREE	Pearson Correlation	**.216
	Sig. (2-tailed)	.002
	N	196

The Teacher Attribute Questionnaire identified that of the 196 teachers participating in this study, 30 taught AP Biology in addition to teaching Biology I, 164 taught Biology I but did not teach AP Biology, and 2 participants did not respond to the question. Table 5 shows that Biology I teachers who also taught AP Biology had a mean PSTE of 57.53 with a standard deviation of 4.584, while Biology I teachers who did not teach AP Biology reported a mean PSTE score of 55.31 with a standard deviation of 5.351. An independent-samples t-test was used to determine if the mean difference in the PSTE between the two groups was statistically significant. The results of the t-test revealed that Biology teachers who also teach AP Biology reported significantly higher PSTE scores [t (192) = -2.135, p = .034] than Biology teachers who did not teach AP Biology.

TABLE 5

Means, Standard Deviations, and Results of the Independent Sample T-Test for Personal Science Teaching Efficacy and Teaching Duty (N = 194)

Teaching Duty	Mean	Standard Deviation
AP Biology + Biology I	57.53	4.584
Biology I only	55.31	5.351

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper	t (194)	p
-2.22	1.041	-4.276	-.169	-2.135	.034

Data obtained from the Teacher Attribute Questionnaire also identified that of the 196 participants in the study, 136 teachers felt their students were prepared to take the EOI Biology I test, while 60 teachers felt their students were unprepared. Table 6 shows that teachers who felt their students were prepared to take the EOI Biology I test had a mean PSTE score of 56.18 with a standard deviation of 5.020. Teachers who felt their students were unprepared to take the EOI test had a mean PSTE score of 54.48 and a standard deviation of 5.792. The results of an independent-samples t-test showed that Biology I teachers who felt their students were prepared to take the EOI Biology I test had statistically higher PSTE scores [t (194) = -2.074, p = .039] than Biology I teachers who did not feel their students were prepared.

TABLE 6

Means, Standard Deviations, and Results of the Independent Sample T-Test for Personal Science Teaching Efficacy and Feelings of Student Preparedness (N = 196)

Feelings of Student Preparedness	Mean	Standard Deviation
Yes	56.18	5.020
No	54.48	5.792

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper	t (194)	p
-1.69	.816	-3.303	-.083	-2.074	.039

Research Question 2

Quantitative Results from Research Question 2: The second question explored the differences in the outcome expectancy, the teachers' belief in their ability to impact student learning regardless of environmental factors, of Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology-I test met or exceeded the level of proficiency (700 and above) – Proficient Group - and Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology I test fell below the level of proficiency (below 700) – Non-proficient Group. The 12 outcome expectancy subscale items were analyzed for the purpose of making group comparisons. One hundred ninety-six Oklahoma Biology teachers responded to the 12 OE items that comprised one of the two subscales on the Science Teaching Efficacy Belief Instrument. Descriptive statistics reporting the mean and standard deviation of each EOI Group is given in Table 4.

TABLE 7

Means, Standard Deviations, and Results of the Independent Sample T-Test for the Outcome Expectancy and EOI Teacher Division Groups (N=196)

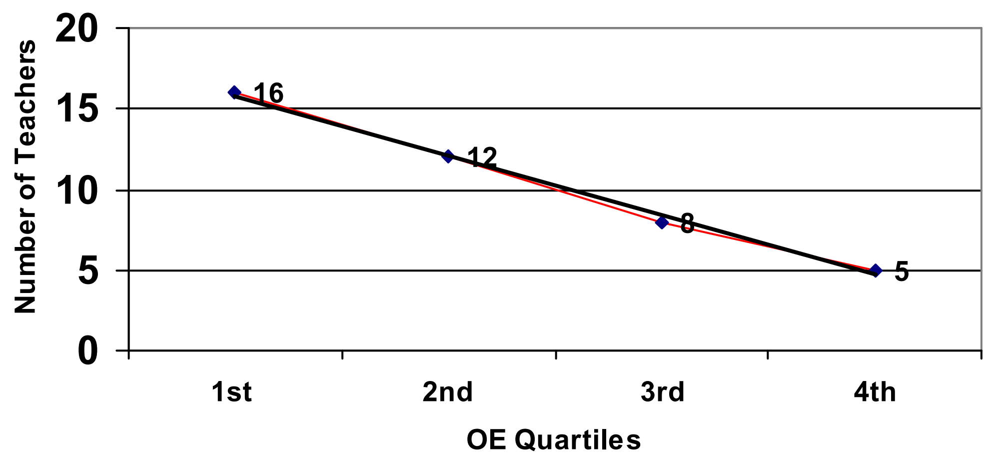
EOI Teacher Group	Mean	Standard Deviation
Non-Proficient	37.79	4.685
Proficient	39.98	4.618

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper	t (194)	p
-2.19	.820	-3.806	-.571	-2.668	.008

With a potential range in scores on the OE subscale of the Science Teaching Efficacy Belief Instrument from 12 to 60, Table 7 shows that the 155 teachers in the Non-proficient Group reported a lower mean score than the 41 teachers in the Proficient Group. The teachers in the Non-proficient Group had a reported OE score of 37.79 while the teachers in the Proficient Group had a reported OE score of 39.98. However, the standard deviations of the two groups were very similar, implying that variances within the groups were the same.

After noting these descriptive differences, an independent-samples t-test was used to determine if the mean difference in the OE scores between the two groups was statistically significant. The 95% confidence level was calculated for the comparison. The result of the t-test is given in Table 7 and defined as follows: The mean difference on the OE subscale scores between Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology-I test met or exceeded the level of proficiency (700 and above) – Proficient Group - and the Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology I test fell below the level of proficiency (below 700) – Non-proficient Group was statistically significant [t (194) = -2.668, p = .008], indicating that outcome expectancy was statistically related to how a teacher's students scored on the EOI Biology I test.

Figure 2. Number of Teachers with Average EOI Scores at or Above 700 by OE Quartiles



To gain a deeper understanding of the significant difference in outcome expectancy between the proficient group and non-proficient group of teachers, the 196 OE scores were arranged from greatest to least and then separated into four quartiles of 49 scores each. In Figure 2 the 1st quartile represents the 49 participants with the highest

OE scores, while the 4th quartile represents the 49 participants with the lowest OE scores. Sixteen teachers in the 1st quartile had mean student EOI Biology I scores at or above 700 (the state proficiency level for Biology I), twelve teachers in the 2nd quartile, eight in the 3rd quartile and five in the 4th quartile had mean EOI scores at 700 or greater. A Pearson correlation coefficient measure was calculated between the number of teachers with mean student EOI Biology I scores at or above 700 and the quartile number where the corresponding teachers OE score fell. An r-value of .998 was calculated. Due to the high r-value between the quartile number and the number of teachers who had mean student scores who met or exceeded the state academic proficiency level on the EOI Biology I test, the assumption can be made that the variables were bivariately normally distributed, meaning that the scores of one variable (number of teachers with student mean EOI scores at or above 700) were related to the scores of the second variable (the quartile number where the corresponding teachers OE score fell). To further measure the strength of the relationship between the two variables the correlation value was squared providing an r^2 value of .996, concluding that 99.6 percent of the variance of the EOI Biology I test scores may be accounted for by Oklahoma Biology teachers OE score.

These findings support the conclusion to reject the null hypothesis as there was a statistical difference in the OE, the belief that teachers can impact student learning, in Biology teachers whose students' mean EOI Biology I scores met or exceeded the state proficiency level and Biology teachers whose students' mean EOI Biology I scores fell below the state proficiency level. The two groups of teachers had dissimilar beliefs in their ability to impact student learning.

Data obtained from the Teacher Attribute Questionnaire was utilized to gain a deeper understanding of the outcome expectancy of the Biology teachers who participated in this study. Of the 196 participants in this study, 30 teachers taught AP Biology in addition to teaching Biology I, 164 taught Biology I but did not teach AP Biology, and 2 participants did not respond to the question. Table 8 shows that Biology I teachers who also taught AP Biology had a mean OE of 40.03 with a standard deviation of 5.116, while Biology I teachers who did not teach AP Biology reported a mean OE score of 37.92 with a standard deviation of 4.643. An independent-samples t-test was used to determine if the mean difference in the OE between the two groups was statistically significant. The results of the t-test revealed that Biology teachers who also taught AP Biology reported significantly higher OE scores [t (192) = -2.255, p = .025] than Biology teachers who did not teach AP Biology.

TABLE 8

Means, Standard Deviations, and Results of the Independent Sample T-Test for Science Teaching Outcome Expectancy and Teaching Duty (N = 194)

Teaching Duty	Mean	Standard Deviation
AP Biology + Biology I	40.03	5.116
Biology I only	37.92	4.643

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference		t (194)	p
		Lower	Upper		
-2.11	.937	-3.960	-.265	-2.255	.025

Data obtained from the Teacher Attribute Questionnaire also identified that of the 196 participants in the study, 136 teachers felt their students were prepared to take the EOI Biology I test, while 60 teachers felt their students were unprepared. Table 9 shows that teachers who felt their students were prepared to take the EOI Biology I test had a mean OE score of 39.00 with a standard deviation of 4.484. Teachers who felt their students were unprepared to take the EOI test had a mean OE score of 36.53 and a standard deviation of 4.908. The results of an independent-samples t-test show that Biology I teachers who felt their students were prepared to take the EOI Biology I test had statistically higher OE scores [t (194) =-3.447, p = .001] than Biology I teachers who did not feel their students were prepared.

TABLE 9

Means, Standard Deviations, and Results of the Independent Sample T-Test for Science Teaching Outcome Expectancy and Feelings of Student Preparedness (N = 196)

Feelings of student Preparedness	Mean	Standard Deviation
No	36.53	4.908
Yes	39.00	4.484

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference Lower	Upper	t (194)	p
-2.47	.634	-3.878	-1.055	-3.447	.001

Research Question 3

Quantitative Results from Research Question 3: The third question explored the differences in EOI Biology I test scores of students taught by a national board certified teacher and EOI Biology I test scores of students taught under the direction of a teacher not holding a national board certification. Of the 196 Oklahoma Biology teachers who responded to this study, only 9 or 4.6% currently held a national certification. Of the 187 teachers that did not hold a national certification, 6 teachers (3.1%) were currently pursuing national board certification or waiting the results, 74 teachers (37.8%) had given serious thought about pursuing national certification some time in the future, while 107 teachers (54.6%) responding to this research study expressed no interest in pursing national certification.

Since Oklahoma schools must demonstrate evidence of “adequate yearly progress” toward meeting state learning standards for students in science, Oklahoma legislators mandated an Oklahoma School Testing Program’s (OSTP) End-of-Instruction (EOI) Criterion-Referenced test (OSTP/EOI) for students at the completion of Biology I. A student with a perfect score on the EOI Biology I test would receive a score of 900. Of the 196 teachers/participants in this research study, the maximum mean student score was 763.74, while the minimum mean score a participant received was 455.00. The mean score of the participating teachers was 683.45 with a standard deviation of 31.48.

TABLE 10

Means, Standard Deviations, and Results of the Independent Sample T-Test for EOI Scores and Teacher Certification Groups (N=196)

Teacher Certification	Mean EOI Score	Standard Deviation
Non-NBCT	683.01	31.907
NBCT	692.64	19.700

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference		t (194)	p
		Lower	Upper		
-9.6304	10.748	-30.83	11.57	-.896	.371

Table 10 displays descriptive results of mean student EOI scores of the 187 teachers not holding a national board certification (Non-NBCT) and the 9 teachers holding a national board certification (NBCT). With a maximum potential EOI score of 900, teachers not holding a national certification reported a lower mean student EOI score than students of national board certified teachers. The Non-NBCT group had a reported mean student EOI Biology I score of 683.01 while the NBCT group had a reported mean EOI score of 692.64. The standard deviations of the two groups were different, 31.91 and 19.70 respectfully, which means that the teachers holding a national certification had less variance in student EOI scores than teachers not holding a national certification. However, due to the small sample size of teachers holding a national certification, the standard error of the mean was larger for the NBCT Group. Table 10 also displays the results of an independent-samples t-test used to determine if the mean difference in the

EOI scores between the two groups was statistically significant. The 95% confidence level was calculated for the comparison. The result of the independent-samples t-test given in Table 10 shows that the mean difference between the two groups was not statistically significant [t (194) = -.896, p = .371], indicating that a national board certification was not statistically related to how a teacher's students scored on the EOI Biology I test.

TABLE 11

Means, Standard Deviations, and Results of the Independent Sample T-Test for OE Scores and Teacher Certification Groups (N=196)

Teacher Certification	Mean OE Score	Standard Deviation
Non-NBCT	38.21	4.697
NBCT	38.89	5.925

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper	t (194)	p
-.67	1.622	-3.875	2.525	-.416	.678

Table 11 displays descriptive results of mean OE scores of the 187 teachers not holding a national board certification (Non-NBCT) and the 9 teachers holding a national board certification (NBCT). With a maximum OE score of 60, teachers not holding a national certification reported the same mean OE scores as teachers who had achieved national board certification. The Non-NBCT group had a reported mean OE score of

38.21 while the NBCT group had a reported mean OE score of 38.89. The standard deviations of the two groups were different, 4.697 and 5.925 respectfully, which means that the Non-NBCT group had less variance in their outcome expectancy than teachers holding a national certification. Table 11 also displays the results of an independent samples t-test used to determine if the mean difference in the OE scores between the two groups was statistically significant. The 95% confidence level was calculated for the comparison.

The result of the independent-samples t-test given in Table 11 shows that the mean difference between the two groups was not statistically significant [t (194) = -.416, p = .678], indicating that a national board certification was not statistically related to how a teacher scored on the outcome expectancy subscale of the Science Teaching Efficacy Belief Instrument.

TABLE 12

Means, Standard Deviations, and Results of the Independent Sample T-Test for PSTE Scores and Teacher Certification Groups (N=196)

Teacher Certification	Mean PSTE Score	Standard Deviation
Non-NBCT	55.41	5.284
NBCT	60.78	2.728

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper	t (194)	p
-5.37	1.776	-8.868	-1.864	-3.022	.003

Table 12 displays descriptive results of mean PSTE scores of the 187 teachers not holding a national board certification (Non-NBCT) and the 9 teachers holding a national board certification (NBCT). With a maximum PSTE score of 65, teachers not holding a national certification reported a mean PSTE score of 55.41 while national board certified teachers reported a mean PSTE score of 60.78. The standard deviations of the two groups were different, 5.284 and 2.728 respectfully, which means that the Non-NBCT group had more variance in their outcome expectancy than teachers holding a national certification. Table 12 also displays the results of an independent-samples t-test used to determine if the mean difference in the PSTE scores between the two groups was statistically significant. The 95% confidence level was calculated for the comparison.

The result of the t-test shown in Table 12, explains that the mean difference between the two groups was statistically significant [t (194) = -.3.022, p = .003], indicating that a national board certification was statistically related to how a teacher scored on the personal science teaching expectancy subscale of the Science Teaching Efficacy Belief Instrument.

TABLE 13

Means, Standard Deviations, and Results of the Independent Sample T-Test for Professional Development Hours and Teacher Certification Groups (N=196)

Teaching Certification	Professional Development Mean	Standard Deviation
Non-NBCT	35.45	49.333
NBCT	127.22	131.941

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference Lower	Upper	t (194)	p
-91.77	18.851	-128.946	-54.589	-4.868	.000

Data obtained from the Teacher Attribute Questionnaire identified three variables that differed between the 9 teachers who were nationally board certified and the 187 teachers who held only the traditional state certification. The three variables were: the number of professional development hours reported during the past two years, the likeliness of teaching an AP Biology course, and the frequency of referring to the national science education standards. Table 13 shows that teachers who held a national certification engaged in significantly more science related professional development [t (194) = -.4.868, p = .000] than teachers not nationally certified. National board certified teachers engaged in an average of 127 science related professional development hours during the past two years, while non-national board certified teachers engaged in an average of 35 hours.

TABLE 14

Means, Standard Deviations, and Results of the Independent Sample T-Test for Teaching AP Biology and Teacher Certification Groups (N=194)

Teaching Certification	Mean AP Biology	Standard Deviation
Non-NBCT	1.16	.391
NBCT	1.56	.527

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper	t (194)	p
-.40	.136	-.668	-.133	-2.949	.004

Table 14 displays descriptive results of scores representing the likeliness of teaching an AP Biology course while also teaching a Biology I course. On the Teacher Attribute Questionnaire, 194 participants answered either, No (1) or Yes (2) for teaching AP Biology; two participants did not respond to the question. Teachers not holding a national certification had a mean score of 1.16 with a standard deviation of .391, while national board certified teachers reported a mean score of 1.56 with a standard deviation of .527. The results of an independent-samples t-test showed that teachers holding a national certification were significantly [t (192) = -2.949, p = .004] more likely to teach AP Biology than teachers not holding a national certification.

TABLE 15

Means, Standard Deviations, and Results of the Independent Sample T-Test for The Use of the National Science Education Standards and Teacher Certification Groups (N=196)

Teaching Certification	Mean NSES Frequency	Standard Deviation
Non-NBCT	1.95	.757
NBCT	2.56	.527

Mean Difference	Standard Error of Mean Difference	95% Confidence Interval of the Difference Lower	Upper	t (194)	p
-.60	.256	-1.108	-.100	-2.362	.019

Table 15 displays the descriptive results of mean scores from question 21b of the Teacher Attribute Questionnaire. Question 21b queried the frequency a teacher refers to the National Science Education Standards in preparation of lessons. To respond to the question, teachers selected *Never*, *Seldom*, or *Often*. The answer choice *Never* received a numerical value of (1), *Seldom* (2), and *Often* (3). The 187 teachers not holding a national certification had a mean score of 1.95 with a standard deviation of .757, while the 9 national board certified teachers had a mean score of 2.56 with a standard deviation of .527. The results of an independent-samples t-test showed that teachers holding a national certification were significantly [t (194) = -2.362, p = .019] more likely to refer to the

National Science Education Standards when preparing for science lessons than teachers not nationally certified.

Research Question 4

Quantitative Results from Research Question 4: The fourth question explored variables that could be used to predict high End-of-Instruction Biology I test scores. Simple correlations typically are difficult to interpret, because they fail to take into account confounding influences among variables. Consequently, a multiple regression analysis was conducted to reduce the influence of confounding factors. The multiple regression analysis examined the validity of each predictor variable, incremental validity of each predictor over other predictor variables, and the validity of combinations of predictor variables. During the multiple regression analysis used in this study, the dependent variable (1) was EOI Biology I test scores, while the independent variables were (2) level of interest in pursuing national board certification, (3) Outcome Expectancy (OE) score, (4) Personal Science Teaching Efficacy (PSTE) Score, (5) location of school as rural, suburban, or urban, (6) class size, (7) number of hours of professional development during the past two years, (8) frequency referencing the Oklahoma PASS standards, (9) level of inquiry (student driven) used in the classroom, and (10) level of student preparation for the EOI test.

TABLE 16

Descriptive Statistics: Means, Standard Deviations, and Intercorrelations (N=196)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) EOI										
(2) NBCT	.062									
(3) OE	.177*	.032								
(4) PSTE	-.067	.192	.052							
(5) LOCA	-.118	-.010	.027	.088						
(6) CLASS-SIZ	-.046	.075	-.057	.103	.542					
(7) PRO-DEV	.064	.366	.121	.059	-.010	.064				
(8) OK PASS	.068	.097	-.015	.041	.052	.069	.090			
(9) INQUIRY	-.053	-.227	-.059	-.138	-.132	-.181	-.124	-.013		
(10) PREPAR	.138	.023	.240	.147	-.027	-.029	-.018	-.070	-.017	
M	683.45	1.58	38.24	55.66	1.51	3.68	39.67	2.84	4.06	1.69
SD	31.48	0.76	4.74	5.31	0.70	1.14	58.36	0.45	0.97	0.46

Note. * indicates constant predictor of high EOI scores.

The regression results in Table 16 were based on the 196 biology teachers for whom complete data on all variables in the analysis were available. The only variable, of the ten selected, that showed statistical significance as a constant predictor of high EOI Biology I test scores was outcome expectancy. A multiple correlation of .177 was obtained, concluding that, while significant, only 2.6 percent of the variance of EOI Biology I test scores was accounted for by a teacher's outcome expectancy. Although not significant, the next highest predictor variable was number 10, how prepared the teacher felt his/her students were to take the EOI Biology I test. The two variables, combined, accounted for 9.9 percent of the variance of EOI scores.

The results of the multiple regression analysis draws into question the validity of what has traditionally been used to identify an effective teacher. Historically, teachers have received monetary increases in salary for receiving advanced degrees, continuing to stay in the teaching profession, teaching advanced placement courses, attending workshops, and achieving national board certification. But the results of the multiple regression analysis report that none of these variables we traditionally honor teachers for can predict student achievement as measured by EOI Biology I test scores.

Conclusion

This study investigated the science teaching efficacy beliefs of 196 Biology teachers across the state of Oklahoma. Quantitative data were collected and analyzed to compare the personal science teaching efficacy and science teaching outcome expectancy beliefs of teachers whose mean student score on the EOI Biology I test met or exceeded the state level of proficiency to the teachers whose mean student score on the EOI Biology I test fell below the level of proficiency. The study also investigated the difference in EOI Biology I test scores of students whose Biology teacher held a national board certification and EOI scores of students whose Biology teacher was not nationally board certified.

This study shows that, while no significant difference existed in the PSTE of teachers whose students were proficient on the EOI Biology I test, and teachers whose students did not score proficient on the EOI test, teachers whose mean student EOI Biology I test scores were proficient, demonstrated significantly higher outcome expectancy. Additionally, this study shows that, although national board certified teachers have a significantly higher PSTE, the belief in one's ability to effectively teach science, than teachers not holding a national certification, the nine NBCTs did not have significantly higher student EOI Biology I test scores. Finally, this study shows that the only constant predictor of EOI Biology I test scores was a teacher's OE, the belief in one's ability to positively impact student learning.

In the next chapter, a summary of the findings and conclusions will be presented.

Chapter V also discusses the implications of the study's findings for teachers, along with recommendations for further research.

CHAPTER V

CONCLUSION

The nation has experienced significant challenges keeping up with the advancements in a global economy. Many believe that educational progress is the key to long-term economic vitality (U.S. Department of Education, 2004; The Teaching Commission, 2004; Southern Regional Education Board, 2005). Scientific research supports teacher quality as a controlling factor in student achievement (Darling-Hammond, 1999; Goldhaber & Anthony, 2004). Therefore, striving to maintain a global economic advantage over other countries, the president of the United States signed into action the No Child Left Behind Act in 2002. The guiding principal behind the NCLB Act reflects the hypothesized relationship between teacher quality and yearly adequate progress in the academic achievement of all students (U.S. Department of Education, 2004). To meet the mandates set by the NCLB Act, each state was given the responsibility of ensuring that all public school teachers demonstrate proof of content knowledge in the subject area he/she was teaching, a minimum of a bachelor's degree, and certification or licensure to teach in that state (U.S. Department of Education, 2004). As a result of the actions employed by the Oklahoma State Department of Education (SDE), more than 98% of all teachers in the state of Oklahoma were considered "highly qualified" according to the regulations mandated by the NCLB Act. To test yearly adequate progress at the high school level, the Oklahoma SDE implemented four End-of-Instruction (EOI) tests with three additional EOI tests to be implemented within the next few years. Although the federal No Child Left Behind Act required districts to test students in science beginning in 2007 (Cavanagh, 2004), the Oklahoma State Department of Education implemented EOI Biology I testing in 2003.

The Oklahoma EOI Biology I test contains 80 questions that implement both content and process skill knowledge that align to the PASS teaching standards for Biology I. Sixty of the questions are identified as operational test items with reported scores culminating as a final score falling in one of four performance levels – advanced, satisfactory, limited knowledge, or unsatisfactory. The remaining 20 are field test questions, with new questions implemented each year. Field test items are reviewed and approved by the state Item Review Committee. If the statistics on the field test item is significant, then the question becomes a valid question for the pool of potential testable questions that appear on the EOI Biology I test. If the statistics on the field test item does not show statistically significance, then the Item Review Committee can either revise the question and field test the question again or completely remove the test item from the pool of questions.

Supported by research, the NCLB Act emphasizes teacher quality (U.S. Department of Education, 2004). As the work of Darling-Hammond (1999) and Goldhaber and Anthony (2003) suggest, nothing is more central to student learning than the quality of the teacher. Under the assumption that teaching is a scientific enterprise that can be weighed and measured, Ferguson (1998) finds that the quality of the teacher could account for a significant amount of variance in student achievement. Gage (1985) asserts that teaching is a mixture of part science and part art, emphasizing that it is what teachers do with their knowledge and abilities that affects student learning. This concept is supported by Bandura's (1977) supposition that the belief in one's ability to impact student learning is not concerned with the skills one has but with the judgments of what one can do with whatever skills one possesses to achieve a positive impact on student learning. For, if teaching were pure science, accountability would be relatively easy to achieve. But for almost four decades of scientific education research, very little is known about why some teachers are more effective than others.

This study examined the science teaching efficacy beliefs of Biology I teachers in the state of Oklahoma whose students were required by the mandates of the NCLB Act to take the End-of-Instruction Biology I test as part of the Oklahoma Schools Testing Program. Additionally, student EOI Biology I scores were used as a dependent variable to identify if teacher certification influenced student achievement. The theoretical framework for this study examined the theory of efficacy identified in Bandura's (1977, 1981, 1986) social cognitive theory. When the social cognitive theory was applied to teaching and the construct of teacher efficacy, two components or dimensions emerged: general outcome expectancy belief (belief that behavior will lead to desirable outcomes) and a self-efficacy belief (belief that one has the necessary skills and abilities to bring about the desired outcome). Later, heeding the suggestions of Bandura (1977, 1981) and Gibson and Dembo (1984) that self-efficacy may be content specific, Riggs and Enochs (1990) developed a Science Teaching Efficacy Beliefs Instrument (STEBI) and identified the two components of the instrument as Personal Science Teaching Efficacy (PSTE) and Science Teaching Outcome Expectancy (OE).

Several studies suggest that these teacher efficacy beliefs may account for individual differences in teacher effectiveness (Berman & McLaughlin, 1977; Brophy & Evertson, 1981, Ashton & Webb, 1982; Gibson & Dembo, 1984). Therefore, the specific research questions that guided this study were as follows:

1. Is there a significant difference between the personal science teaching efficacy of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) and the PSTE of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700)?
2. Is there a significant difference between the science teaching outcome expectancy of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) and the OE of Oklahoma Biology teachers whose students' mean scores on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700).
3. Is there a significant difference between the EOI Biology I test scores of biology students taught by a national board certified teacher and EOI Biology I test scores of biology students taught by a teacher not holding a national board certification?

4. What relationships exist between teacher attributes (i.e., level of degree, years of teaching experience, number of professional organizations, membership in professional development, level of teacher-direction used in the classroom, and use of state or national science standards) and students' mean score on the Oklahoma EOI Biology I test?

The participants in this study were 196 Oklahoma Biology teachers currently teaching and who taught biology the previous year in the school they were currently teaching. One hundred and seventeen of the participants were female and 79 were male. With participants ranging from under 25 years to over 61 years of age, the average age group of the participants was in the 41-45 year age group. The most frequent age group responding to this study was 31-35 years of age. The study employed quantitative data collection and analysis with open-ended responses on seven questions from the questionnaire. Participants completed a Teacher Attribute Questionnaire and a Science Teacher Efficacy Belief Instrument.

The statistical procedures used to analyze quantitative data yielded both descriptive and inferential statistics. The analysis was computed using SPSS 11.0 statistical package (SPSS, 2001). Researchers often state the need for both statistical significance, such as alpha values, as well as practical significance, such as confidence intervals. These should be complementary concepts (Creswell, 2003; Bluman, 1992). Therefore, in addition to statistical tests, confidence intervals were reported. This allowed the examination of the degree of variability in the corresponding populations from which the sample was drawn.

Summary and Discussion of Research Questions

Research Question 1 Summary and Discussion. The first research question examined the difference in personal science teaching beliefs of Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology I test met or exceeded the level of proficiency to those of Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology I test fell below the level of proficiency. One-hundred fifty-five teachers reported mean student EOI scores below the state proficiency level (non-proficient teacher group), while only forty-one teachers reported mean student EOI scores at or above the state proficiency level (proficient teacher group). When analyzed as a whole construct, quantitative data analysis of the PSTE (self-efficacy subscale) on the STEBI demonstrated no statistically significant difference between the personal science teaching efficacy of the non-proficient teacher group and the proficient teacher group. Both groups reported a mean PSTE score of 55. The difference between the two groups was in the standard deviation. The Proficient teacher group had a smaller standard deviation, 4.533, than non-proficient teacher group, indicating that proficient teacher group had less variance in their responses.

This finding suggests that the belief that Oklahoma Biology teachers hold in his/her science content knowledge, as well as in his/her ability to teach science effectively to help students learn was independent of student EOI Biology I scores. Pajares (2002) explains that self-efficacy influences the choices people make and the course of action pursued; thus, individuals tend to select tasks and activities in which they feel competent and confident, and avoid those in which they do not. This could mean that some Biology teachers may not have the belief that they are competent to teach all the content and process skills identified in the Oklahoma Priority Academic Student Skills (PASS) as the minimum criteria for student achievement in Biology I. Teachers may select the content and process skills familiar and important to them personally, instead of addressing all the standards the state requires. But regardless of a teacher's belief in their personal ability to teach science, students' scores may be independent of their teacher's belief. Tschannen-Moran, et al (1998) state that personal teaching efficacy has been shown to influence the goals teachers promote in their classrooms. Teachers with low levels of efficacy often expend little effort in finding additional materials and planning lessons that challenge students, and display little variety in their teaching strategies. Teachers with high levels of efficacy are more likely to seek out resources and develop challenging lessons, persist with students who struggle and teach in a multitude of ways to promote student understanding (Pajares, 1996; Tschannen-Moran, 1998; Ashton and Webb, 1986). Although the non-proficient teacher group and the proficient teacher group had significantly different student EOI scores the PSTE scores were the same. This indicated a lack of relationship between PSTE and EOI Biology I scores.

This result was also supported by the finding that, although the 30 teachers who reported teaching AP Biology -- in addition to teaching Biology I -- had significantly higher PSTE scores, [$t(192) = -2.135$, $p = .034$], than the 164 teachers who reported not teaching AP biology; there was no significant difference [$t(192) = -.966$, $p = .335$] in the mean student EOI Biology I test scores between the two groups. It would be easy to assume that due to the extra training in content and pedagogical knowledge suggested of a teacher teaching AP biology by the College Board's Advanced Placement Program, AP biology teachers should have more confidence and a higher belief in his/her ability to teach than a teacher who had no AP training and teaching experience (College Board, 2000). In fact, in his State of the Union address on January 31, 2006, President George W. Bush called for the training of 70,000 high school teachers over five years for Advanced Placement science and math courses through the President's Advanced Placement Incentive Program (Bush, 2006). But despite this extra training and resulting higher PSTE score, students of Oklahoma AP Biology teachers did not score significantly higher on the EOI Biology I test than students taught by teachers who had not experienced the AP training. This finding contradicts the findings of Goldhaber (2002) and Edie, Goldhaber, and Brewer (2004), who recognized that a teacher's knowledge of his/her subject matter was associated with high student performance, especially in the areas of mathematics and science. Thus, according to Goldhaber (2002), teachers trained in AP biology should have higher PSTE scores due to their increased content and pedagogical knowledge which should result in increased student EOI Biology I scores.

And finally, this finding was further supported by the lack of a statistical correlation between PSTE scores and the number of science related professional development hours reported during the past two years. No statistical correlation (r-value = .059) was found to exist between the belief that a teacher holds in his/her ability to effectively teach science, and the number of professional development hours during the previous two years. Teachers attend professional development training to increase content and pedagogical skills. Thus, one would expect that the more professional development training a teacher attended the higher his/her PSTE score. In fact, most schools require teachers to attend a minimum specified number of professional development hours for rehiring. School systems encourage teachers to seek out professional development training to keep abreast of current changes in a teacher's content area. But Darling-Hammond (1999) suggests that subject matter does not strongly or consistently relate to teacher effectiveness as measured by student outcomes. Thus, following Darling-Hammond's (1999) concept of teacher effectiveness, PSTE alone would not be an indicator of high EOI Biology I scores. Student achievement may not be determined based on the depth of a teacher's content knowledge, but how the teacher chooses to present that knowledge to students and how misconceptions are addressed (Porter & Brophy, 1988). Bandura (1997) and Ross (1994) postulated that efficacy would be most malleable early in a teachers career, while among experienced teachers, efficacy beliefs become more stable even when teachers were exposed to workshops and new teaching methods.

To gain a deeper understanding of the variables that affected PSTE, further statistical analysis was conducted. This study found that personal science teaching efficacy was positively correlated -- at a 95% level of confidence -- with three variables on the Teacher Attribute Questionnaire filled out by each of the 196 participants. First, although this study did not find correlations between PSTE and years in the teaching profession or PSTE and years specifically teaching high school Biology; this study did find that as the age of the teacher increased so did the PSTE score (r-value = .167). Darling-Hammond (1999) and Goldhaber (2002) found evidence to support the belief that experienced teachers (usually teachers associated with increased age) were more effective with students than entry level teachers (teachers new to the teaching profession) because experienced teachers had more practice to draw from. However, the benefits of additional years of experience appeared to level off early in a teacher's career, about five years, unless a teacher chose to make conscious improvements or modifications in their learning and teaching (Darling-Hammond, 1999; Goldhaber, 2002).

The level of college degree -- bachelor's, master's, or doctorate -- was also positively correlated with PSTE scores (r-value = .216). Darling-Hammond, Wise, and Klein (1995) concluded that teachers with more education were more effective in the classroom. Darling-Hammond continued by stating that teachers with advanced degrees were able to provide higher quality instruction. An advanced college degree, especially if the degree made available content and pedagogical knowledge, opposed to just content knowledge, provided teachers with the competency to create and adapt instructional strategies to meet student needs (Good & Brophy, 1991).

Finally, teachers who felt his/her students were prepared to take the EOI Biology I test reported significantly higher [t (196) = 2.074, p = .039] PSTE scores than teachers who felt his/her students were not prepared to take the EOI Biology I test. Bandura (1986) and Gibson & Dembo (1984) proposed that a teacher with high PSTE believed he/she had the abilities, such as content knowledge and pedagogy skills to perform the necessary tasks to bring about positive student change. Ashton & Webb (1986) reported that high efficacy teachers maintained high academic standards, had clear expectations, concentrated on academic instruction, and maintained students' standards.

Despite earlier research findings (Gibson & Dembo, 1984; Riggs & Enochs, 1990; Tschannen-Moran & Hoy, 1998), this study did not find that high personal science teaching efficacy was associated with increased student achievement as measured by mean student End-of-Instruction Oklahoma Biology I scores. Reflecting on Bandura's social cognitive theory, how people interpreted the results of their own behavior informs and altered their environments and the personal factors they possessed, which in turn, informed and altered subsequent behavior (Bandura, 1986). This was the foundation of Bandura's conception of reciprocal determinism. Thus, if teachers had received high student scores on previous EOI Biology I tests, belief in their ability to successfully teach Biology to students would be high, and they would continue to teach biology with confidence. On the other hand, teachers whose students had successively received low scores on EOI Biology tests may earn the belief that his/her knowledge of biology and how to teach biology was inadequate. At the time this study was conducted, the EOI Biology I test had only been administered to students for three years. Teachers may still be adjusting their content knowledge and teaching strategies to meet the new demands and expectations of this high-stakes test. Possibly, when teachers learn more of the EOI tests expectations, PSTE will be a better predictor of EOI Biology I scores.

Research Question 2 Summary and Discussion. The second research question examined the difference in the science teaching outcome expectancy of Oklahoma Biology teachers whose students' mean score on the Oklahoma EOI Biology I test met or exceeded the level of proficiency (advanced or satisfactory; 700 or above) to those of Oklahoma Biology I teachers whose students' mean score on the Oklahoma EOI Biology I test fell below the level of proficiency (limited knowledge or unsatisfactory; below 700). One-hundred fifty-five teachers reported mean student EOI scores below the state proficiency level (non-proficient teacher group), while forty-one teachers reported mean student EOI scores at or above the state proficiency level (proficient teacher group). The non-proficient teacher group reported a mean OE of 37.79, while the proficient teacher group reported a mean of 39.98. When analyzed as a whole construct, quantitative data analysis of the OE (outcome expectancy) subscale on the STEBI demonstrated a statistically significant difference between the science teaching outcome expectancy of the non-proficient teacher group and proficient teacher group. Teachers (proficient teacher group) whose mean student EOI Biology I score met or exceeded the state proficiency level, 700 or above, had significantly higher [(t (194) = 2.668, p = .008] OE scores than teachers (non-proficient teacher group) whose mean student score fell below the level of proficiency, at a 95% level of proficiency. Both groups had a standard deviation of 4.6, meaning that both groups of teachers had the same variance in their responses.

This finding suggests that End-of-Instruction Biology I test scores were related to the expectations that a Biology teacher held for his/her students to learn biology regardless of student home environment, availability of classroom materials, or student motivation. From previous research findings, teachers with high OE assumed much of the responsibility for student learning instead of shifting the responsibility onto the student (Berman & McLaughlin, 1977; Gibson & Dembo, 1984; Riggs & Enochs, 1990; Tschannen-Moran, & Hoy, 2001). By accepting responsibility for student learning, teachers demonstrate behaviors conducive to increases in student learning. Gibson and Dembo (1984) identified through classroom observation data that teacher efficacy may influence certain patterns of classroom behavior known to yield achievement gains. For example, teachers, who in general expect students to learn, 1) provide less criticism to students and persist with students until they respond correctly rather than going on to another student or another question, 2) communicate clear expectations for students while maintaining on-tasks behaviors, and 3) maintain high academic standards for all students

(Gibson & Dembo, 1984; Ashton & Webb, 1986; Allinder, 1995). These behaviors, applied to Oklahoma Biology teachers, may find teachers with high OE engaging students in inquiry activities, presenting materials for whole class discussions, and developing alternative teaching strategies to reach more students. These characteristics differ from teachers with low OE who may use the textbook as the driving force behind the curriculum, provide numerous worksheets where students work independently, or engage students in small group discussion independent of other group interaction (Gibson & Dembo, 1984; Allinder, 1995).

Students who are familiar with data interpretation and peer collaboration would score higher on the EOI Biology I test due to the format style of the test. Most of the 80 test items (60 operational and 20 field test items) contain both content and process skills as identified by the Oklahoma Priority Academic Student Skills (PASS) for Biology I. While biology content knowledge is important to score above the level of proficiency (700 or above), the process of applying that knowledge is also tested on the EOI Biology I test. Consequently, students routinely exposed to scientific inquiry -- identifying problems, hypothesizing, experimenting, drawing conclusions, and defending results – as part of their biology curriculum find the EOI test a more familiar format than students routinely exposed to traditional lecture style format where worksheets and independent work were commonly used to learn content.

Two variables obtained from the Teacher Attribute Questionnaire were statistically related to teachers' outcome expectancy score. Question # 22 asked teachers if he/she taught AP biology in addition to teaching biology I. Thirty teachers reported teaching AP biology while 164 identified themselves as not teaching AP biology; two participants failed to respond to the question. Teachers who taught biology but not AP biology reported a mean OE score of 37.92 with a standard deviation of 4.6, while the 30 teachers who reported teaching AP biology in addition to Biology I had mean OE score of 40.03 with a standard deviation of 5.1. Although the variance in item responses was slightly higher in the teachers who taught AP biology, the teachers who taught AP biology in addition to teaching Biology I showed a significantly higher outcome expectancy score [$t(194) = 2.255$, $p = .025$] at the 95% level of confidence than teachers who did not report teaching AP biology.

Advanced Placement courses, such as AP biology, provide students with opportunities to engage in high-level critical thinking and intellectual pursuits through rigorous instruction. Advanced Placement examinations as well as course descriptions use standards set by college and university professors who administer AP exam questions to their own students (College Board, 2000). The AP program recognizes teachers as the key to raising student achievement, therefore, while the AP program does not have a set of formal requirements that teachers must satisfy prior to teaching an AP course, the program suggests that AP teachers have considerable experience, and usually an advanced degree in the discipline before teaching an AP course (College Board, 2000). To enhance the skills of prospective AP teachers, professional development workshops offer intensive subject-specific training on the content and methods of teaching AP courses, and serve as a forum for exchanging ideas. Trainers of AP courses model lessons used during the course. Bandura (1986, 1997) postulates four sources of self-efficacy information: vicarious experiences, mastery experiences, physiological and emotional arousal, and social persuasion. Advanced Placement training provides teachers with all four sources of support. Throughout the AP professional development workshops, trainers demonstrate lessons that met with success in the classroom. Through this vicarious experience, teachers observe the success of others and believe that they also have the capabilities to be successful teachers under similar circumstances. Additionally, the workshop provides teachers with opportunities to actually conduct the laboratory activities expected of their students. Bandura (1977, 1986) identified this mastery experience as the most powerful source of efficacy information. Successfully executing a lesson provides teachers with strengthened efficacy beliefs. And finally, while teachers master the lessons under the guidance of a trainer, the working environment provides the positive verbal support system necessary for the teacher to believe that they possess the capabilities to teach AP biology.

With the intense AP training, it would be reasonable to assume that teachers who teach AP biology would have significantly higher OE scores than teachers who had not gone through the training or not had the opportunity to teach an AP course. The AP professional development workshops train teachers to maintain a classroom environment that is conducive to the development of higher-order critical thinking skills in their students. For those teachers, who, in general, expect students to learn, and who have confidence in their ability to teach, communicate higher expectations to their students.

The second variable obtained from the Teacher Attribute Questionnaire that statistically related to teachers' outcome expectancy score was if a teacher felt his/her students were prepared to take the EOI Biology I test. Of the 196 teachers who participated in this study, 136 teachers felt his/her students were prepared to take the EOI Biology I test, while 60 did not feel his/her students were prepared. Teachers who felt their students were prepared had a mean OE score of 39.0 with a standard deviation of 4.5, while teachers who felt their students were not prepared had a mean OE score of 36.5 with a standard deviation of 4.9. An independent samples t-test revealed that teachers who felt their students were prepared to take the EOI Biology I test reported a significantly higher outcome expectancy score [$t(194) = -3.447$, $p = .001$] than teachers who stated their students were not prepared, at a 95% level of confidence.

It was interesting to note that, although a teacher's belief in the preparedness of his/her students was related to the personal belief in their ability to bring about student achievement regardless of students' background or SES, preparedness was not related to EOI Biology I test scores. While 136 teachers felt their students were prepared to take the EOI Biology I test, only 41 teachers had mean student scores above the state proficiency level of 700. Researchers have demonstrated that teachers with high outcome expectancy demonstrate professional characteristics in the classroom that help students to succeed. Such characteristics include using a range of teaching strategies and interaction styles rather than a single rigid approach, assign work relevant to students understanding and interest, demonstrate clear expectations of rules and standards, and provide students with skills and procedures that give them the capacity to learn independently (Porter & Brophy, 1988; Darling-Hammond, 1999; Riggs & Enochs, 1990; Guskey, 1988).

Research Question 3 Summary and Discussion. The third research question examined the difference between the EOI Biology I test scores of biology students taught by a national board certified teacher and EOI Biology I test scores of biology students taught under the direction of a teacher not holding a national certification. The National Board of Professional Teaching Standards (NBPTS) provides an avenue for identifying professional accomplishment in the teaching field. Established in 1987, the NBPTS was one of the first organizations to employ a content specific, standards-based approach for identifying highly effective teachers. This independent, nonprofit, nonpartisan organization developed a rigorous teaching assessment centering on five core propositions found in a policy statement entitled "What Teachers Should Know and Be Able to Do;" it outlines the National Board's values and beliefs about exemplary teaching (National Board of Professional Teaching Standards, 2005).

Of the 196 participants in this study, only 9 held a national board certification; six participants were currently pursuing national certification or waiting for the results during the time of the study; seventy-four of the participants had given serious thought to pursuing national board certification sometime in the future; and 107 had no interest in pursuing national board certification. The 9 national board certified teachers reported a mean student EOI Biology I score of 692.6 with a standard deviation of 19.7, while the 186 teachers not holding a national certification had a mean student EOI Biology I score of 683.0 with a standard deviation of 30.9. Although the national board certified teachers had a higher mean student EOI score, the difference between the two groups was not statistically significant [t (194) = .896, p = .374].

The lack of statistical difference between the achievement of students taught under the guidance of a national board certified teacher as measured by the EOI Biology I test, and the achievement of students taught under the guidance of a teacher not holding a national certification contradicts earlier research findings (Department of Education, 2000; Farrell, 2005; Goldhaber & Anthony, 2004). Goldhaber and Anthony (2004) found that students taught from national board certified teachers, on average, had higher end-of-year test scores in both mathematics and reading. The results of Goldhaber and Anthony (2004) were explained using the belief that NBPTS valued particular constructivist approaches to teaching that may be more or less effective when applied with different types of students or to students of varying ages or academic achievement levels (Wilcox, 1999; Ballou, 2003). *The Accomplished Teaching Validation Study*, conducted by a team of researchers based at the University of North Carolina, revealed that NBCTs scored statistically higher on 11 of 13 dimensions of teaching expertise over teachers who sought after but did not achieve National Board Certification (Bond, et al, 2000). The dimensions included attributes such as 1) having an extensive knowledge of subject matter; 2) the ability to adapt and improvise instruction, 3) formulating lessons that were challenging and engaging, and 4) promoting academic achievement by emphasizing both personal accomplishment and intellectual engagement.

To gain a deeper understanding of the beliefs that NBCTs had compared to teachers not holding a national certification, statistical analyses were conducted on the personal science teacher efficacy and outcome expectancy between the two groups. An independent-samples t-test recognized that teachers holding a national board certification had a significantly higher personal science teacher efficacy (PSTE) score [$t\ (194) = 3.022$, $p = .003$] than teachers not nationally board certified. In the open-response portion of the Teacher Attribute Questionnaire, even though all nine of the national board certified teachers acknowledged that one of the motivating factors for pursuing a national certification was the increased financial reinforcement that came with achieving national certification, all nine teachers further explained that the process of pursuing national board certification increased his/her reflective thinking regarding the lessons used in the classroom and increased pedagogical knowledge applicable to the level of student in their classroom. In Bandura's theoretical framework of efficacy, beliefs are part of the foundation upon which behaviors are based, and, that through self-reflection, people make sense of their experiences, explore their own cognitions and self-beliefs, engage in self-evaluation, and alter their thinking and behavior accordingly (Bandura, 1986). Several studies investigating teacher efficacy beliefs indicate that these beliefs may account for individual differences in teacher effectiveness (Armor et al., 1976; Berman & McLaughlin, 1977). Applying Bandura's theory of self-efficacy to teachers, one might predict that teachers who had confidence in their own teaching abilities should be more receptive to new ideas on implementing innovative instructional practices that may reach more students (Guskey, 1988), greater commitment to learning (Evans & Tribble, 1986) persist longer with students until they respond correctly rather than going on to another student (Gibson & Dembo, 1984), and maintain the confidence in their content knowledge to effectively teach science (Riggs, Scharmann, & Enochs, 1995) Thus, the national board certified teachers in this study support the findings of the *Accomplished Teaching Validation Study* in their beliefs and actions of being an accomplished teacher (Bond, et al, 2000).

This study also recognized that no statistical difference [t (194) = -.416, p = .670] existed in the outcome expectancy (OE) of national board certified teachers and teachers not holding national certification. This lack of statistical difference suggests that holding a national board certification does not increase the expectations that a biology teacher holds for his/her students to learn biology, regardless of a student's home environment, availability of classroom materials, or student motivation. This may suggest that while pursuing national board certification increases a teacher's belief in his/her own abilities to teach science effectively, the process does not aid in the teachers belief to execute the behaviors that result in the academic success of all students.

The nine national board certified teachers in this study did score significantly higher on three variables from the Teacher Attribute Questionnaire than the 187 teachers not holding a national certification. First, teachers holding a national certification engaged in significantly more, [t (194) = -4.868, p = .001], professional development that directly related to science education during the past two years than teachers not holding a national certification. However, the professional development variable was not statistically related to PSTE, OE, or student EOI Biology I test scores.

Second, teachers holding national certification were significantly more likely to teach AP Biology than teachers not nationally certified, [t (194) = -2.949, p = .004]. Teachers holding national certification demonstrated a greater tendency to engage in the professional development required to achieve advanced placement certification. Advanced placement courses, such as AP Biology, were designed to offer students a rigorous curriculum in a specific content (College Board, 2000). Thus, AP teachers must possess the content knowledge and teaching skills worthy of teaching such a course. Through a rigorous, year-long assessment, teachers who earn the Board's national, advanced certification show they meet high standards that assessed their knowledge of children, subject matter, and their ability to put that knowledge to use effectively (The Southeast Center for Teaching Quality, 2004; Department of Education, 2000). Thus, national board certified teachers would be more likely to accept the challenge of teaching AP courses.

Finally, teachers possessing national certification were significantly more likely to refer to the National Science Education Standards when preparing for lessons than teachers not holding a national certification [t (194) = -2.362, p = .019]. In the open response portion of the Teacher Attribute Questionnaire, when explaining how the national board certification process impacted their teaching, two teachers reported that, through the process of national certification, they became more "aware of the *Standards*."

The National Board for Professional Teaching Standards emphasizes the content standards, themes or strands, and pedagogy expressed by the National Research Council in the National Science Education Standards (National Board for Professional Teaching Standards, 2002). Therefore, teachers having achieved national certification refer to the *Standards* when addressing the questions in the four portfolio entries.

Research Question 4 Summary and Discussion. The fourth research question examined the variables from the Teacher Attribute Questionnaire and Science Teacher Efficacy Instrument as predictors of high EOI Biology I test scores. Using a multiple regression analysis, responses from 196 Biology teachers identified that a teacher's OE, the teacher's belief in their ability to impact student learning regardless of environmental factors, was the only significantly consistent predictor of high EOI Biology I test scores. Although OE was a significant predictor for high EOI Biology I test scores, the variable could only account for 2.6 percent of the variance when confounding factors were compensated for. Goldhaber and Anthony (2004) advocate teacher success in the classroom, as measured by student test scores, is dependent on the teacher's enthusiasm and ability to convey knowledge to students. While enthusiasm is not a teacher attribute typically measured in education productivity studies, the ability to convey knowledge regardless of a student's background may closely parallel a teacher's outcome expectancy. This study has shown that student EOI Biology I test scores were related to a teacher's belief in their ability to organize and execute science content and process skills to where all students, regardless of background, can achieve academically.

Extended Information: Since the teacher and school attributes accounted for a small level of variance in EOI Biology I test scores, variables outside a teacher's or a school's control were investigated. While student EOI Biology I test scores and school names were already obtained, the percent of free/reduced lunch count for each school was retrieved from the SDE website. Using a Pearson's correlation data analysis with an alpha of .05, a strong correlation [F (188) = .292, p = .000] was found to exist between EOI Biology I test scores and the number of students on the free/reduced lunch program. This means that, as the percentage of students placed on the free/reduced lunch program increased, the school's student mean EOI Biology I test score decreased by .46 points. Thus, 8.5% of the variable (percentage of students enrolled on the free/reduced Lunch program) could account for the EOI Biology I test scores. Similar findings span four decades of educational research on student achievement (Coleman Report, 1966; Ellinger, Wright, and Hirlinger, 1995; Okpala, Smith, Jones, & Ellis, 2000). The Coleman report suggested "schools bring little influence to bear upon a child's achievement that is independent of his background and general social context" (Coleman, Campbell, Hobson, McPartland, Mood, Weinfeld, & York, 1966, p. 325). While a student's SES is beyond the control of a school or a district, a teacher's belief that all students regardless of his/her SES is within the controllable limits.

Conclusion

In this study the belief a teacher held in his/her students' ability to learn biology was significantly related to EOI scores. Apparently when teachers assume much of the responsibility for student learning instead of shifting the responsibility onto the students, teachers demonstrate behaviors conducive to increases in student achievement (Berman & McLaughlin, 1977; Gibson & Dembo, 1984; Riggs & Enochs, 1990; Tschannen-Moran, & Hoy, 2001). This supports Bandura's (1977) supposition that the belief in one's ability to impact student learning is not concerned with the skills one has but the judgments of what one can do with whatever skills one possesses to achieve a positive impact on student learning. The findings of this study also showed that Biology I teachers who also taught AP Biology had a significantly higher PSTE, belief in their ability to teach science effectively and a higher OE, belief in his/her students' ability to learn biology regardless of their home environment than teachers who did not teach AP Biology. Additionally, teachers who felt their students were prepared to take the EOI test had a significantly higher PSTE and OE than teachers who felt their students were not prepared to take the EOI Biology test. The results of this study indicated that the belief teachers had in their own ability to teach science effectively was not related to the mandated EOI Biology I scores.

This study also identified that, while national board certified teachers held higher beliefs in their ability to teach science effectively, they did not have significantly higher mean student EOI Biology I test scores. Also, the national board certified teachers participating in this study did not report significantly higher OE scores than teachers not holding a national certification.

There is little doubt that the national board certified teachers in this study were accomplished teachers and provided exemplary learning opportunities for their students (Farrell, 2005; Goldhaber & Anthony, 2004; NBPTS, 2005). Although these commendable teachers provided positive learning environments for their students, based on the data collected in this study, the content and/or process skills taught in the classroom were not measurably reflected on the Oklahoma EOI Biology I test. Additionally, since AP Biology teachers had significantly higher PSTE and OE scores of teachers not AP certified, it would be justifiable to assume that AP teachers would have higher student EOI Biology scores than teachers not certified in AP Biology. Like the NBCT, the AP teacher may provide students with rigorous lessons that challenged their students in both content and process skills, but these learned skills were once again not measurably reflected on the EOI Biology I test (College Board, 2000; Bush, 2006; Monk, 1994).

Implications

This study has valuable implications for Biology teachers and school administrators in Oklahoma. The results show that the belief that a teacher holds in their ability to effectively teach biology does not impact the mandated student EOI Biology I test scores as much as the belief a teacher holds in his/her ability to bring about student learning. Thus, this study provides two suggestions for educational practice and funding.

First, the in-service programs offered to Biology teachers should be configured to attend to the diverse behaviors and beliefs of participants. Although PSTE was not statistically related to EOI test scores, a teacher's content knowledge and belief in their ability to teach science is important to student learning (Darling-Hammond, 1999;

Dembo & Gibson, 1984; Goldhaber & Anthony, 2003). However, in-service programs should consider strategies that boost a science teacher's belief in their ability to create a classroom where teaching strategies can bring about student learning regardless of students' personal background. Pajares (1992) concluded that beliefs are a result of personal experiences and are often difficult to change. The Inquiry-Based Demonstration Classroom (IBDC) in-service program reported that for professional development to refine both the beliefs and practices of teachers, the duration should extend for several years, not the traditional one-day, five-day, or one-month program (Luft, 2001). Furthermore, follow-up opportunities may maximize changes in beliefs and practices. Applying Bandura's (1986) sources of self-efficacy information, workshops that provide teachers with vicarious and mastery experiences by actually executing lessons utilized in the classroom for students of all learning styles provide an avenue to increase the teacher's outcome expectancy. Additionally, the IBDC in-service program reported additional increases in teachers' beliefs through feedback based on classroom observations (Luft, 2001). The positive verbal words of encouragement facilitate teachers in overcoming situational obstacles with the lesson (Guskey, 1984). Oklahoma Biology teachers who work with professional development staff to learn how to conduct and implement lessons that meet the National Science Education Standards and the Oklahoma PASS standards, during a long term professional development program, may observe the benefits manifested by increased student EOI Biology I test scores.

Second, all "highly qualified" science teachers in Oklahoma, according to the NCLB Act, have met minimum standards. But, as this study shows, not all "highly qualified" teachers produce the same student academic gains. The belief that a teacher has in his/her students to succeed appears to be a variable that lies within a teacher's control. Results indicate that evidence of change in the learning outcomes of students may be an essential element in promoting affective changes in teachers (Guskey, 1984). Thus, teachers who accept more responsibility for student learning by changing instructional practices to meet the needs of their students may see increased test scores.

Recommendations for Future Research

It is interesting to note that when the participants in this study were categorized into four groups: nationally board certified, currently pursuing national board certification, thinking about pursuing national certification in the future, and not interested in pursuing national certification, a distinct difference was found in the percent of students enrolled in the free/reduced lunch program of the teachers' school. The last two groups (thinking about pursuing in the future and not interested) taught at schools where 42% of the student body was on a free/reduced lunch program. Teachers currently pursuing national certification taught at schools where 56% of the student body was enrolled in the free/reduced lunch program, while only 34% of the student body was enrolled in the free/reduced lunch program at the schools where a national board certified teacher taught. This may indicate that quality teachers in high risk schools, as measured by the percent of students enrolled in the free/reduced lunch program, may value the financial incentive and professional development opportunities afforded by achieving a national certification. Then after a teacher attains a national teaching status, they may become more marketable to schools with less poverty, more equipment, and better salaries. Replacing the experienced national board certified teacher may be an inexperienced entry level teacher.

Further research needs to be conducted on the affects that a teacher's PSTE and OE have on the results of student scores on the Oklahoma School Testing Program's End-of-Instruction Biology I Criterion-Referenced test. The more science teachers understand about how their beliefs impact student learning the more students will learn. Recommendations for further research based on findings from this study leads to the following possible explorations:

- To gain a better understanding of the benefits of the national board certification process, additional studies should be conducted that involve a larger number of national board certified teachers and student EOI Biology I test scores from schools of different SES.
- Bandura (1977) emphasizes that efficacy is content specific; therefore the construction and validation of an instrument that focuses on the biology teaching efficacy, opposed to science teaching efficacy, needs to be developed.
- To gain a better understanding of the benefits of the national board certification process, additional studies should be conducted that involve a larger number of national board certified teachers and student EOI Biology I test scores.
- Longitudinal studies should be conducted to determine whether PSTE and OE change as a teacher pursues national certification or AP certification. This may determine if teachers with high PSTE and OE pursue additional certifications or if the certification process increases a teacher's PSTE or OE.
- Additional studies should be conducted to further explore relationships

between EOI Biology I test scores and socio-economic status/poverty rate of students enrolled in a school or district.

Limitations

This study had four limitations that should be noted if additional studies with similar purposes are undertaken. First, although the number of total participants in this study represented over 25% of the general Biology teacher population, only nine teachers held national certification. An increased number of participants holding national board certification would likely increase the representation of the general population, thereby, providing results more generalized to the teaching population. Second, this study was limited to biology teachers who voluntarily returned the consent form, the STEBI and the Teacher Attribute Questionnaire. Third, this study was limited by the fact that, since a biology teaching efficacy instrument was not found, participants were asked to mentally substitute the word biology for science when reading the STEBI, and, finally, although the STEBI has been used for secondary science teachers, in other studies, the wording of the STEBI is more favorable for elementary teachers than secondary science teachers.

Concluding Comments

The conclusions of this study foster a deeper understanding of the science teaching efficacy beliefs and outcome expectancy beliefs of Biology teachers whose students took the EOI Biology I test, as mandated by the Oklahoma State Department of Education, in fulfillment of the NCLB Act. Data analysis yielded that the beliefs in the expectations that a biology teacher holds for his/her students to learn biology, regardless of student home environment, availability of classroom materials, or student motivation, was the only tested variable related to high EOI Biology I test scores.

With an emphasis on quality teaching, and high stakes testing as a measure of student achievement, a better understanding of the characteristics that deem a teacher as “highly qualified” need to be explored. Therefore, if the EOI Biology I test measures what it claims to measure then teacher characteristics that have warranted salary increases are questioned. Traditionally, teachers have received a stipend or an increase in salary for additional years in the teaching profession, advanced degrees, attending professional development workshops, and attaining national board certification, none of which related in this study to student EOI Biology I test scores that met the state proficiency level.

Caution needs to be made in assuming that just because students do not achieve at the proficient level on the EOI Biology I test, learning is not taking place in the classroom. Researchers have demonstrated over and over again that AP Biology teachers and national board certified teachers have had significant gains in student academic achievement. One quantitative instrument should not be used to determine the quality the teacher or the academic gains of the student.

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APPENDICES

APPENDIX A

IRB APPROVAL

Oklahoma State University Institutional Review Board

Date:	Friday, September 16, 2005
IRB Application No	ED0622
Proposal Title:	Teacher Efficacy: A Predictor of High School Students' end-of-Instruction (EQI) Biology I Scores
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 9/15/2006

Principal Investigator(s

Julie Angle Rt. 1 Box 130 Medford, OK 73759	Richard Bryant 245 Willard Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 415 Whitehurst (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Sue C. Jacobs

Sue C. Jacobs, Chair
Institutional Review Board

APPENDIX B

TEACHER ATTRIBUTE QUESTIONNAIRE

High School Biology Teacher Survey

Today's date: ________________

Teacher Name - ____

School Name - ____

School Address - ____
Street address

____
City zip code

School Phone Number - ____
(Area code)

Did you teach Biology I at this school during the 2004-2005 school year (last year)?
Yes or No

How many teachers at your school taught biology I last year other than yourself?
____

This personal information has been placed on a separate page from the formal questionnaire so it can be removed to ensure anonymity of participants' responses.

Personal Information

1. Age (circle one): 25 or under; 26-30; 31-35; 36-40; 41-45; 46-50; 51-55; 56-60; above 61
2. Gender: M or F (circle one)
3. Ethnicity: Hispanic or Latino; or Not Hispanic or Latino
4. Race (circle one): White Native Hawaiian or Other Pacific Islander
   Asian Black or African American
   American Indian or Alaska Native
5. Are you a national board certified teacher? Yes or No **If no, skip to question 6**.
   5b. If yes, what is your certification area? ______________________________

   5c. What year did you become nationally board certified?_________________

   5d. Explain how the national certification process impacted your teaching?____

____
____
____
____
____

   5e. Why did you choose to go through the process of national board certification?

____
____
____

****Please skip to question # 7.**

6. Place an X next to the response that best describes your situation:
   a. __________ I am currently pursuing national board certification.
   b. __________ I have given serious thought about pursuing national board certification.
   c. __________ I have no interest in pursing national board certification at this time.

7. Place an X to the left of the highest college degree you have obtained and the date you received the degree on the right:
   _____ Bachelor _____________________
   _____ Master _______________________
   _____ Doctorate _____________________

8. Was your major in college (circle one):

Biology
Another science, please specify_______________
Science education
Other, please specify _______________________

9. What was your minor in college? _________________________________

10. Were you certified through (circle one):

a) the traditional teacher education program.

b) the Oklahoma alternative certification program.

School Demographics

11. Check the description that best describes the community where your school is located:

_____ Rural
_____ Suburban
_____ Urban

12. What is the average class size of your biology classes in any given semester?

5-10 11-15 16-20 21-25 26-30 31-35 above 36 students

13. Last year, was your school on (circle one): Block scheduling
6 period day
7 period day
8 period day
Other, please specify____________________

14. What percent of your last years' biology students were:
Freshmen _____ Juniors _______ Sophomores _____ Seniors _______

15. List the courses you taught last year and the number of sections of each course.

Course	# of sections

Teaching Experience

16. How many years have you been in the teaching profession? ______________

17. How many years have you taught biology? __________________

18. Please make an X next to the organization(s) your currently belong to:
National Science Teachers Association - __________
National Association of Biology Teachers - __________
National Physics Teacher Association - __________
Oklahoma Science Teacher Association - __________
Oklahoma Association of Environmental Education - __________
Oklahoma Education Association - __________
Others: ____

20. How many hours have you spent in professional development activities, **specifically related to science teaching**
During the past year? ________________________
During the past two years? ____________________
During the past five years? ____________________

21a. How often do you refer to the National Science Education Standards when planning your biology lessons or units?
_____ Never _____ Seldom _____ Often

21b. How often do you refer to the Oklahoma PASS standards when planning your biology lessons or units?
_____ Never _____ Seldom _____ Often

22. Do you currently teach an AP biology class? Yes or No (circle one)

23. If on a scale of 1 to 5, where 1 represents a classroom environment that is student driven (students design their own questions to investigate, set up their own experiments, and draw their own conclusions) and 5 represents a classroom environment that is teacher driven (the teacher designs the curriculum, selects the laboratory activities to be conducted, and expects predetermined answers), Where would your classroom be? (circle the number)
Student driven…..1……….2……….3……….4……….5……Teacher driven

23b. Please explain why you selected the above numerical value to represent your classroom environment.

____
____
____
____

24. When your students take the End-of-Instruction Biology test do you think your students are prepared?
Yes or No (circle one)….. Please explain your answer: _________________

____

____

____

25. How do you prepare your students for the End-of-Instruction Biology I test?

____

____

____

26. What would help you better prepare your biology students for the EOI Biology I test?

____

____

27. Do you use the test preparation materials provided by the State Department of Education for the EOI Biology I test? Yes or No (circle one)

28. Do you use other test preparation materials to prepare your students for the EOI Biology I test?

Yes or No (circle one)

If yes, what kind(s) of materials do you use? ____________________________

____

____

____

29. In your biology classroom, how do you assess student learning? Check all that apply.

_____ multiple choice answers
_____ essay answers
_____ portfolio
_____ laboratory reports
_____ other, please specify
_____ short answers
_____ individual or group projects
_____ demonstrations
_____ oral presentations

May I contact you with additional questions if clarification of response(s) is/are needed?

Yes or No (circle one)

What is the best way to contact you?____

____

Thank you very much for taking the time to respond honestly to this questionnaire.

APPENDIX C

SCIENCE TEACHER EFFICACY BELIEF INSTRUMENT (STEBI)

STEBI

Science Teacher Efficacy Belief Instrument

Please indicate the degree to which you agree or disagree with each statement below by choosing the appropriate number to the right of the statement. Please choose one answer for Science and one answer for Biology.

1	2	3	4	5
Strongly Disagree	**Disagree**	**Uncertain**	**Agree**	**Strongly Agree**

	Science	**Biology**
1. When a student does better than usual in science, it is often because the teacher exerted a little extra effort.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
2. I am continually finding better ways to teach science.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
3. Even when I try very hard, I don't teach science as well as I do most subjects.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
4. When the science grades of students improve, it is most often due to their teacher having found a more effective teaching approach.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
5. I know the steps necessary to teach science concepts effectively.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
6. I am not very effective in monitoring science experiments.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
7. If students are underachieving in science, it is most likely due to ineffective science teaching.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
8. I generally teach science ineffectively.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
9. The inadequacy of a student's science background can be overcome by good teaching.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
10. The low science achievement of some students cannot generally be blamed on their teachers.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
11. When a low achieving child progresses in science, it is usually due to extra attention given by the teacher.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
12. I understand science concepts well enough to be effective in teaching basic high school science.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
13. Increased effort in science teaching produces little change in some students' science.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
14. The teacher is generally responsible for the achievement of students in science.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
15. Students' achievement in science is directly related to their teacher's effectiveness in science teaching.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
16. If parents comment that their child is showing more interest in science at school, it is probably due to the performance of their child's teacher.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
17. I find it difficult to explain to students why science experiments work.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
18. I am typically able to answer students' science questions.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□

19. I wonder if I have the necessary skills to teach science.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
20. Effectiveness in science teaching has little influence on the achievement of students with low motivation.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
21. Given a choice, I would not invite the principal to evaluate my science teaching.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
22. When a student has difficulty understanding a science concept, I am usually at a loss as to how to help the student understand it better.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
23. When teaching science, I usually welcome student questions.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
24. I don't know what to do to turn students on to science.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□
25. Even teachers with good science teaching abilities cannot help some kids learn science.	1-□ 2-□ 3-□ 4-□ 5-□	1-□ 2-□ 3-□ 4-□ 5-□

*In Riggs, I., & Enochs, L. (1990). Towards the development of an elementary teacher's science teaching efficacy belief instrument. *Science Education*, 74, 625-637.

APPENDIX D

INFORMATIONAL LETTER

Julie Angle
Alva High School
Alva, OK 73717
(580) 327-3682

Date

Dear High School Biology Teacher (participant's Name)

My name is Julie Angle. In addition to a 22 year career in secondary science education, I am also a doctoral student at Oklahoma State University. I am currently working on my dissertation in the area of science teaching efficacy, biology teaching efficacy in particular. Thus, as a Biology teacher in the state of Oklahoma, I am seeking your assistance as a participant in this research.

If you agree to participate in this study you will be asked to complete a Teacher Attribute Questionnaire, a Science Teacher Efficacy Belief Instrument, and an informed consent form. Your participation in this study will require approximately twenty minutes of your time and no cost. All postage will be assumed by the researcher. To maintain participant anonymity all data will be stored in a locked file cabinet in my home office and at no time will your name or the name of your school be revealed in the study.

As someone who has devoted their professional life to helping children experience science, you can understand the importance of generating information to help existing teachers as well as pre-service teachers in the state of Oklahoma become better teachers. Producing better teachers will ultimately result in an increase in student learning. The data obtained from this study could add to the literature of science education in the state of Oklahoma. Thus, your participation is very important to the validity of this study.

Respectfully,

Julie Angle
RR 1 Box 130
Medford, OK 73759

APPENDIX E

INFORMED CONSENT FORM

CONSENT FORM

"I, ______________________________, hereby authorize or direct Ms. Julie Angle or Dr. Richard Bryant
(please print your first and last name) to perform the procedures listed here.

A. Purpose: Your participation is part of an investigation entitled "Biology Teacher Efficacy." The purpose of this study is to examine the beliefs that teachers have about teaching high school biology I courses and how these beliefs relate to teaching and learning.

B. Procedure: As a part of this study, you will be asked to complete: 1) a Science Teaching Efficacy Belief Instrument (STEBI) and, 2) a questionnaire designed to gather information about your personal background, academic background (such as age, gender, national certification status, and college degree), school demographics (such as school and class size, and school location), and teaching experience (such as professional affiliations, professional development involvement, pedagogy, and EOI preparation). In addition, End-of-Instruction Biology I test scores will be retrieved by the researcher from the State Department of Education and correlated anonymously to survey responses.

C. Risks of Participation: There are no known risks associated with this project which are greater than those ordinarily encountered in daily life.

D. Length: Your involvement in this study is limited to one calendar year, September 2005 – September 2006. Your participation in this study is entirely voluntary, and you can withdraw your consent at any time and discontinue participation without penalty.

E. Benefits: This study will provide information that may be used by universities and state and local education agencies to improve the preparation and professional development of Oklahoma biology teachers.

F. Confidentiality: For the purposes of this study, you will be assigned a numerical identifier. As data are collected, the data will be rendered completely anonymous and will be associated only with your numerical identifier. All information containing your name (including this consent form) will be kept separate from numbered materials and in a secure place (in a locked filing cabinet in a locked office or private residence). Quantitative data will be reported statistically, thus removing personal identifiers. All collected data will be destroyed one year after the completion of this study.

I understand that participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time without penalty after notifying the project director."

I may contact Julie Angle at (580) 395-2633 or Dr. Richard Bryant at (405) 744-8005 if I have questions or concerns about this study. For information on your rights as a participant in this research contact Dr. Sue C. Jacobs, IRB Chair, 415 Whitehurst Hall, (405) 744-1676.

I have read and fully understand the consent form. I sign freely and voluntarily. A Copy has been given to me.

____ ______________________

Signature of Participant Date

I certify that I have personally explained this document before requesting that the participant sign it.

Signed: ______________________________________ ______________________

Project Director Date

VITA

JULIE MARIE ANGLE

Candidate for the Degree of

Doctor of Philosophy

Thesis: TEACHER EFFICACY, A PREDICTOR OF HIGH SCHOOL STUDENTS' END-OF-INSTRUCTION (EOI) BIOLOGY I SCORES

Major Field: Education

Biographical:

Personal Data: Born in San Francisco, California, the daughter of Winnifred McChesney and Bill Robinson. Married to Mark Angle and mother of Crystal, David, Heather and Cale.

Education: Graduated from San Marin High School, Novato, California in June 1976; attended Northwestern Oklahoma State University, Alva, OK on January 1977; transferred to Oklahoma State University, Stillwater, OK and received a Bachelor of Science degree in 1980 with a Major in Science and a minor in Science Education. Earned a Master of Education with an emphasis in Science from Northwestern Oklahoma State University, Alva, OK in 1983. Completed the requirements for the Doctor of Philosophy degree with a major in Professional Education Studies and a specialization in science education at Oklahoma State University, Stillwater, Oklahoma, May 2006.

Experience: High school science classroom teacher and science department head at Alva High School, Alva, Oklahoma 1983-present; Adjunct Faculty Northwestern Oklahoma State university, 1990; Septic Shock research assistant for the Oklahoma Medical Research Foundation, OKC, Oklahoma, 1992-1994. Master Teacher Project instructor for the Oklahoma SDE and SEDL, 1997-2001. Achieved National Board Certification in AYA Science, 2003.

Professional Memberships: National Science Teachers Association, Oklahoma Science Teachers Association, Coalition for the Advancement of Science and Mathematics in Oklahoma, National Association for Research in Science Teaching, National Association for Biology Teachers, NEA and OEA.

Name: Julie Marie Angle Date of Degree: May, 2006

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: TEACHER EFFICACY, A PREDICTOR OF HIGH SCHOOL STUDENTS' END-OF-INSTRUCTION (EOI) BIOLOGY I SCORES

Pages in Study: 147 Candidate for the Degree of Doctor of Philosophy

Major Field: Education

Scope and Method of Study: The NCLB Act requires all states to set standards for student progress for grade level achievement and to monitor student academic progress. Thus a teacher questionnaire and STEBI were mailed to 750 Biology teachers across the state of Oklahoma with 196 teachers responding to the study. These instruments were used to determine if significant differences existed in the PSTE and OE of teachers whose students' mean scores on the EOI Biology I test met or exceeded the state proficiency level (proficient group) to the PSTE and OE of teachers whose students' mean scores on the EOI Biology I test fell below the state proficiency level (non-proficient group). In addition, this study was designed to determine if a significant difference existed between EOI Biology I test scores of students taught under the guidance of a NBCT and EOI Biology I test scores of students taught under the guidance of a teacher without national certification.

Findings and Conclusions: Although no significant difference [t (194) = .098, p = .922] existed in the PSTE between the proficient group of teachers and the non-proficient group, teachers in the proficient group reported significantly higher [t (192) = -2.255, p = .025] OE beliefs than teachers in the non-proficient group. These findings suggest that although the proficient and non-proficient group of teachers had similar beliefs about their effectiveness to teach science, a teachers OE beliefs were statistically related to how a teacher's students scored on the EOI Biology I test. This study also found that even though students of teachers holding a national board certification had higher mean EOI Biology I test scores than students of teachers' not nationally board certified, the difference was not statistically significant [t (194) = -.896, p = .371] at the 95% level of confidence. This lack of significance was largely due to the small sample of NBCTs (9) and the large number of teachers not nationally board certified (187). The results of this study revealed that the only constant predictor of high EOI Biology I test scores was a teacher's outcome expectancy beliefs.

ADVISER'S APPROVAL: Dr. Richard Bryant