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The Impact of Collective Teacher Efficacy on Student Achievement in High School Science

Mark W. Burcham
Gardner-Webb University

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By
Mark W. Burcham

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Approval Page

This dissertation was submitted by Mark W. Burcham under the direction of the persons listed below. It was submitted to the Gardner-Webb University School of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Gardner-Webb University.

Victoria Ratchford, EdD — Date
Committee Chair

David Shellman, EdD — Date
Committee Member

Jane King, EdD — Date
Committee Member

Jackson Rainer, PhD — Date
Dean of Graduate School

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Abstract

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This dissertation was designed to examine the impact of collective teacher efficacy on high school science achievement by looking at relationships among collective teacher efficacy, its two constructs, group competence and group task analysis, and high school science achievement scores at four rural high schools in Northwestern North Carolina.

The researcher gathered historical test data from the testing coordinator from the school system and then administered the Collective Teacher Efficacy Instrument, developed by Goddard, Hoy, and Woolfolk Hoy (2000), to 24 science teachers from the four high schools. Using this information, the researcher conducted statistical analyses to determine the relationships among collective teacher efficacy, group competence, and group task analysis as compared with the tested science curriculum (physical science, biology, chemistry, and physics). The researcher also examined which construct was the most contributing factor and examined differences in efficacy levels and student achievement levels at each high school.

Analysis of the data from this study indicated collective teacher efficacy, as well as its two constructs, group competence and group task analysis, does have a positive impact on student achievement in high school science. Analysis of the data revealed group competence is the major contributing factor for student achievement in biology and group task analysis is the major contributing factor for student achievement in physical science, chemistry, and physics. Further analysis of the data in this study, also revealed that the two high schools with the highest levels of collective teacher efficacy had the highest levels of student achievement.

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Chapter 1: Introduction

Introduction

According to a National Assessment of Education Progress (NAEP) report from 2005, twelfth graders across the United States have shown steady declines in science achievement since 1996. Despite the increase in accountability standards from the No Child Left Behind Act, the development of National Science Education Standards, and years of education reform efforts, only modest gains have been made in a few areas of science proficiency. The National Academies (2006) reported, however, overall achievement in science continues to decline. Beginning in 2007 all states must have included a measure of student achievement in science according to the No Child Left Behind Act (The National Academies). North Carolina has been measuring student achievement in science, however, since the mid-1980's (North Carolina Department of Public Instruction, 2007). Even with these measures, large gains in overall student proficiency in science have not been achieved according to archived testing data that may be found on the North Carolina Public School's website referenced above. This same phenomenon holds true for the students in the rural northwestern school system of North Carolina that was the focus of this study.

The school system considered in this study is in a rural county in northwestern North Carolina. The county has approximately 10,000 students in grades pre-kindergarten through 12 with four high schools that average 696 students each (North Carolina School Report Card, 2006). The school system's dropout rate averages 6-8% annually. In this school system, students are tested in the science subjects of physical science, biology, physics, and chemistry at the end of each 90-day term using the 4 x 4 scheduling system. The school system was chosen for this study because the high schools are very similar to

what is considered an average size high school across North Carolina, the school system is a low wealth system, and opportunities for science careers as a part of the local economy are very few. These factors make the high schools in this school system very typical of most of the systems across North Carolina (North Carolina Department of Public Instruction, 2007).

North Carolina high school students are currently expected to pass a course in biology and two other science courses in order to graduate from high school. Beginning with freshmen who entered high school during the 2006-07 school year, every student must show proficiency by scoring a level III on five end-of-course tests (Algebra I, English I, Biology, Civics and Economics, and U.S. History) as well as successfully completing a graduation project (North Carolina Department of Public Instruction, 2007).

For the purpose of this study, only science scores were considered. The new competency requirements for high school graduation include students scoring a level III (proficient level) on the biology end-of-course test as well as passing two other courses in science in order to graduate. Looking at the past 4 years of test data for the four high schools in the county (see Table 1), it is clear that only in the area of physics are students achieving at a high-level of proficiency. It should be noted that for the 2006-07 school year data were only available for biology due to new test norming that took place with the other three tests. When looking at these scores, it is important to keep in mind all students in this school system are required to take biology and physical science (a local system standard), while chemistry and physics are elective courses primarily taken by students in their junior and senior years. It should also be noted that the physical science, chemistry, and physics tests were renormed during the 2006-2007 school year; therefore data for these tests were not available for that school year. The scores below also represent the

system's proficiency level as a whole.

Table 1

Percentage of Students Proficient in Science

School Year	Physical Science	Biology	Chemistry	Physics
2003-04	70.7% (N=600)	67.0% (N=614)	88.4% (N=319)	>95% (N=48)
2004-05	78.3% (N=663)	70.8% (N=623)	89.4% (N=261)	>95% (N=49)
2005-06	81.2% (N=662)	72.6% (N=649)	91.8% (N=257)	>95% (N=25)
2006-07	No Data	70.3% (N=556)	No Data	No Data

According to the trend, represented by the data above, nearly 30% of this school system's class of 2010 will not be able to graduate without extensive remediation and retesting because they will not have scored a level III on their biology end-of-course test. Student proficiency levels in physical science and chemistry also indicate many students are not showing proficiency in the subject of science. It is also notable that large gains from year to year are not attained, although much staff development has taken place such as Kagan Structures, Learning Focused Schools, Thinking Maps, best practices training, and science safety training.

Science proficiency of students has a greater impact on students than just graduating from high school. Proficiency in science means that students must have an understanding of scientific principles as well as demonstrate a deeper understanding of the scientific processes which will allow them as entry-level workers to reason, think creatively, and solve problems (The National Academies, 2006). Colwell (2003) suggested a science-literate workforce is a vital part of our future. A 2007 publication, *State Scholars Initiative*, from the United States Department of Education also suggested

the necessity of a science-literate workforce by reporting that some 70% of employers report workers to be deficient in the areas of critical thinking and the ability to use knowledge, facts, and data to solve problems. The same study suggested 57.5% of employers rank critical thinking as a very important characteristic to successful job performance.

The National Science Teachers Association (NSTA, 2001) suggested that to improve student achievement levels (proficiency) in science, students must be taught by teachers who are effective and competent. Research further suggests that teacher effectiveness and competence may be related to teacher efficacy (Huitt, 2000; Tschannen-Moran & Woolfolk Hoy, 2001; Ross & Bruce, 2007). Teacher efficacy is defined as a teacher's belief in his or her own capabilities to bring about a desired learning outcome or level of achievement regardless of outside influences or difficult situations (Tschannen-Moran & Woolfolk Hoy). Ross (1994) indicated teachers with a high level of efficacy were more likely to learn and use new approaches, build positive student perceptions of themselves, and be persistent enough to figure out how to help failing students. Woolfolk Hoy (2004) also indicated teachers with high levels of self efficacy were less critical of student mistakes and spent much more time with struggling students trying to make a difference.

Other research indicates that the collective teacher efficacy within a school may have a direct correlation with student achievement within a school as well (England, 2006; Garcia, 2004; Goddard, Hoy & Woolfolk Hoy, 2000; Larrick, 2004; Schwarzer, Schmitz, & Daytner, 1999). Goddard et al. defined collective efficacy as "the perceptions of teachers in a school that the efforts of the faculty as a whole will have a positive effect on students" (p. 480). Goddard et al. also concluded from their studies that the level of

collective efficacy in a school was an even greater contributing factor to student achievement than socioeconomic status. Manthey (2006) suggested this is an extremely important factor in raising student achievement levels since it is much easier to change or influence the collective efficacy of a group than to change the socioeconomic status of the students in a school. Bandura (1997) also concluded that the collective efficacy of any group is a direct factor in what any group can accomplish.

Statement of the Problem

Although many reform efforts have taken place in education throughout the years, never before has there been such a need to raise achievement levels in science. This is especially true with the needs found in many workplaces where critical thinking skills, problem solving skills, and the need to use and manipulate technology are at an all time high (The National Academies, 2006). Therefore, a need to find ways to enhance student achievement in science is necessary. Larrick (2004) suggested variables such as school climate, school culture, and socioeconomic status can affect student achievement. Larrick also suggested collective efficacy in recent literature seems to be an important variable in student achievement. While several studies indicate a direct link between teacher efficacy, collective teacher efficacy, and student achievement, none of these studies focus on a link between the achievement levels of high school science students as they relate to the collective efficacy of science teachers (England, 2006; Garcia, 2004; Goddard et al., 2000; Larrick, 2004; Schwarzer et al., 1999). Instead, all prior studies focus on elementary and middle school levels, with reading and mathematics being the intended target areas.

As previously mentioned, several strategies have been implemented over the years to try to enhance student achievement in science in the rural northwestern school

system in North Carolina. None of these efforts has been successful in making large gains in student achievement, however. Therefore, this study focused on the impact of the collective efficacy of science teachers in the four high schools in this school system on student achievement and proficiency levels in science in order to look for a possible route for future professional development.

Purpose of Study

The major purpose of this study was to determine the impact of collective science teacher efficacy on student achievement in science. In order to measure the collective teacher efficacy of the science teachers at each of the four high schools, a survey instrument called the Collective Teacher Efficacy (CTE) instrument developed by Goddard et al. (2000) was used. This survey instrument may be found in Appendix A. The survey data were then compared to student performance on each science subject tested by end-of-course tests at each of the four high schools to determine the impact of collective efficacy on science achievement. The group competence construct and the group task analysis construct of the CTE instrument were then related to student achievement in each of the tested science subjects. Further analysis was conducted to determine if group competence or group task analysis had a greater, if any, impact on collective teacher efficacy.

Overview of Study Design

This study was a quantitative correlational study using a non-experimental approach. The study was a point-in-time study using the Collective Teacher Efficacy instrument designed by Goddard et al. (2000) to measure the collective efficacy of high school science teacher from the four high schools in a rural school system in Northwestern North Carolina. The collective efficacy measured by the instrument can be

further broken down into the two constructs of group competence and group task analysis. These two constructs, as well as the whole group's collective efficacy, were compared to end-of-course test scores for biology, physical science, chemistry, and physics using a correlation matrix.

Individual teacher mean scores of collective teacher efficacy, group competence, and group task analysis were compared to the 2007-2008 student achievement scores in biology, physical science, chemistry, and physics using a correlation matrix. A brief statistical analysis examined differences in student achievement between schools, as well as teachers, and examined differences in collective teacher efficacy, group competence, and group task analysis between the schools. A multiple regression determined whether the group competence construct or the group task analysis construct had the most impact, if any, on student achievement in science.

Brief Description of Procedures

The researcher administered the CTE survey instrument to science teachers at the four high schools during regularly scheduled, district-wide staff development meetings beginning in September 2008. The CTE instrument was used to find the total collective teacher efficacy, the total group competence, and the total group task analysis for each of the science teachers at the four high schools. The student test data by subject (biology, physical science, chemistry, and physics), by school, by teacher, and by student scale score were collected from the district-level testing director. Several statistical procedures were used to analyze the data gathered during this study. Overall scores were determined for each teacher's level of collective efficacy, group competence, and group task analysis. Mean scale scores were also determined for each teacher and school's biology, physical science, chemistry, and physics, as well as district level mean scale scores. Descriptive

statistics were used to compare each school's collective efficacy, group competence, and group task analysis. A multiple regression also determined how the group competence or group task analysis constructs impacted student achievement in science. Descriptive statistics provided data to look for differences in achievement levels at each school.

Research Questions

In order to achieve the purpose of this study, the following questions were addressed:

1. What is the impact of collective teacher efficacy on student achievement on the tested North Carolina science curriculum?

2. What is the impact of group competence on student achievement on the tested North Carolina science curriculum?

3. What is the impact of group task analysis on student achievement on the tested North Carolina science curriculum?

4. Which construct of collective efficacy, group competence or group task analysis, impacts student achievement the most in the tested North Carolina science curriculum?

5. What differences, if any, exist among student achievement on the tested North Carolina science curriculum at each of the four high schools in relation to collective efficacy, group competence, and group task analysis?

Definition of Terms

For the purposes of this study, the following definitions are applicable.

1. *Collective Teacher Efficacy*. Collective teacher efficacy is a construct measuring teachers' beliefs about the collective capability to influence student achievement as perceived by the whole faculty (Goddard et al., 2000). For this study, the

whole faculty will be the science teachers at each respective site.

2. *Student Achievement*. Collective student scale score as measured through North Carolina's end-of-course testing program for the subjects of biology, physical science, chemistry, and physics.

3. *Group Competence*. Collective teaching efficacy construct which consists of judgments about the capabilities of a faculty to bring about positive results in a given teaching situation. The construct is measured by questions 1, 2, 3, 4, 5, 17, and 18 on the Collective Teacher Efficacy (CTE) instrument in a positive manner and questions 6, 7. 8, 9, 10, and 21 on the CTE instrument in a negative manner.

4. *Group Task Analysis*. Collective teaching efficacy construct which consists of the perceptions of the constraints and opportunities inherent to the task at hand. This term also includes teachers' beliefs about the level of support provided by the students' homes and communities. This construct is measured on the CTE instrument in a positive manner by questions 11, 12, 15, 16 and in a negative manner by questions 13, 14, 19, and 20.

5. *Tested North Carolina Science Curriculum*. This term refers to the courses of biology, physical science, chemistry, and physics. These courses have end-of-course standardized tests that are administered to students upon completion of the course.

Summary

This chapter focused briefly on the need for improved science achievement. Despite many movements in education to enhance student achievement, little gain has been made in the area of science achievement. Little gain is highly evident in the historical data provided for the school system in this study. While numerous studies have been done relating elementary and middle school student achievement in reading and mathematics to collective teacher efficacy, no studies have been done relating high

school science achievement and collective efficacy. This study examined the impact of collective efficacy of high school science teachers on science achievement.

Chapter 2: Review of Related Literature

Introduction

This chapter will begin with a look at related literature which deals with the importance of student proficiency in science. Following the importance of student proficiency in science, the review will continue with a look at important background history of the social sciences leading up the beginning of the terminology of teacher efficacy. As the chapter continues, the review will examine various research studies on measuring teacher efficacy. The next portion of the review will consider research on collective efficacy and means to measure collective efficacy, followed by an exploration of literature on how individual teacher efficacy impacts student achievement and how collective teacher efficacy impacts student achievement respectively. The last portion of the review will touch briefly on how to build collective efficacy with a school.

The Importance of Science Proficiency

According to The National Academies (2006) report, major changes are needed in the way science is taught as well as the way it is understood and grasped by students. The National Academies suggested that science proficiency means students should not only understand scientific vocabulary and ideas, but should also be able to demonstrate scientific processes either through example or experimentation. The National Academies report also showed four components to the definition of science proficiency:

a) students should be able to relate to and explain the natural world,
b) students should be able to come up with evidence and explanations and evaluate their evidences,
c) students should understand the scientific process, and
d) students should be able to actively participate in scientific collaboration. (p. 3)

Haury (2002) pointed out those students who can become proficient in science also benefit society by adding technological capital to the workplace and society in general. Haury also added to this point by stating that science should be taught through a design approach so that it engages students and enhances students' abilities to forge connections to daily life and develop critical thinking skills, problem solving, and decision-making skills. These skills carry heavily into the workplace. Haury emphasizes that, "Scientific inquiry is driven by the desire to understand the natural world, and technological design is driven by the need to meet human needs and solve human problems" (p. 3). The United States Department of Education (2007) and Colwell (2003) added to Haury's argument by indicating that the workplace is demanding workers who are proficient in science and have the ability to think creatively, problem solve, engage in information technologies, and collaborate in cross-disciplinary discussions to find solutions. Colwell suggested that everyone needs an understanding of science whether they are scientists or not. Colwell also related to a quote by John Kenneth Galbraith that says a society will not improve with unimproved people.

The Education Commission of the States (2008) recently made an effort to respond to this need for higher proficiency levels in science by providing states with a database of resources for high school science, technology, engineering, and mathematics (STEM) courses. The Education Commission of the States concurs with the already mentioned stance that the workforce has a vast shortage of workers who are able to engage in information technologies and have problem solving skills necessary to readily adapt to an ever-changing technological world. According to the Education Commission of the States, the database of resources will help policymakers adjust policy to enhance the proficiency level of students in these STEM courses.

How proficient students are in science will also determine how sound judgments of environmental and natural resources are made in the future. Being able to make informed and scientifically sound decisions relating to the environment will play a huge role in the way the future is shaped by energy, water, forests, minerals, and other resources. The ever-global business economy needs workers who are informed and can make sound scientifically based judgments by implementing the problem-solving technique of the scientific method (Haury, 2002; The National Academies, 2006).

North Carolina’s Department of Public Instruction (2006) stated that students should be proficient in science by advocating the new graduation requirements for 2006-07 freshmen, that all students score a level III or proficient level on the end-of-course test for biology. North Carolina high school students must also pass two other science courses in order to graduate.

Locus of Control

Locus of control is considered to be an important aspect of personality. The concept was originally named locus of control of reinforcement by Julian Rotter in the 1950’s (Neill, 2006). Locus of control refers to an individual's perception about the underlying main causes of events in his/her life. According to Neill, Rotter was attempting to bridge the behavioral and cognitive realms of psychology by looking at rewards and punishments and how individuals perceive these reinforcements in relation to their lives when he coined the term, locus of control.

Neill (2006) stated a locus of control orientation is a belief about whether the outcome of one’s actions is based on what he or she does (internal control) or whether the outcome of one’s actions is based on events outside of his or her personal control (external control). Internal locus of control people believe that through their behavior

they can control the likelihood of receiving reinforcements or that they basically have a lot of control over what happens. External locus of control people do not see as much of a link between their behavior and the likelihood of being rewarded or controlling what happens. Tschannen-Moran, Woolfolk Hoy and Hoy (1998) credited this theory as being the basis for the first efficacy studies conducted by the Rand corporation where researchers measured how teachers' beliefs of internal and external control impacted outcomes for reading programs. These constructs of internal locus of control and external locus of control are important to this study because Goddard et al. (2000) used these constructs as the basis for their collective teacher efficacy survey instrument. Within this survey, Goddard et al. set up two constructs, group competence and group task analysis. The group competence construct is directly related to the internal locus of control by asking questions to teachers about things they have direct control over within the school setting. The group task analysis construct is directly related to the external locus of control by asking teachers questions about things they do not have direct control over outside the school setting that impact learning.

Social Cognition

The main theoretical framework for teacher efficacy lies in the social cognitive research by Albert Bandura. Bandura (1997) stated that "perceived self efficacy refers to the beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3).

Bandura's (1997) distinction between one's expectations about one's ability to implement a strategy and one's expectations about the outcomes of those strategies drives the measurement aspect of self efficacy. Although these two determinants are distinct, they are related in determining one's behavior and actions that make up the person's self

efficacy.

There tend to be four major sources of efficacy expectations. These are performance accomplishments, vicarious experiences, verbal persuasion, and physiological and emotional states (Bandura, 1977). Performance accomplishments are based on mastery experiences, both positive and negative. Tschannen-Moran et al. (1998) reported that these mastery experiences are the strongest source of efficacy expectations for teachers because success or failure in actual teaching experiences provide first-hand information about one's own ability to control courses of action. Bandura (1995) also suggested that successful mastery experiences raise efficacy expectations, obviously, while failure lowers expectations. However, timing of failures as well as frequency as compared to successes can lead to more meaningful successful experiences as long as successes outweigh failure experiences.

Vicarious experiences are mental experiences that a person has in his/her own mind, through watching another person demonstrate an act or skill. Bandura (1977) stated the more closely an observer is able to identify with the person modeling, the stronger the impact of efficacy will be. Schunk (1984) also contended that skills and behaviors that teachers identify as competent models can have an influence over one's self-perception of competence as well.

Bandura's (1977) third source of efficacy, verbal persuasion, may take on many forms such as pep talks, performance feedback, suggestions, self-instruction, and student evaluations to name a few. Positive verbal messages are more likely to cause people to be encouraged to exert greater effort and persistence. Positive verbal messages are also more likely to provide a boost to counter setbacks. Negative verbal persuasions can weaken a person's self-belief and hinder one's performance. The potency of the verbal persuasion

depends on how the person giving the persuasion is viewed by the listener. Trustworthiness, credibility, and expertise of the persuader play a vital role (Bandura, 1997; England, 2006; Woolfolk Hoy, 2004). Bandura, however, pointed out verbal persuasion has much less effect than performance experiences or vicarious experiences.

Bandura (1997) suggested that physiological states such as stress, fear, and anxiety can create feelings of being incompetent and have a negative impact on performance. Tschannen-Moran et al. (1998) indicated performance is positively impacted and the perception of competency is enhanced when physiological states such as excitement, elation and relaxation exist. Bandura suggested that mastery experiences associated with positive physiological states can have an even stronger impact in raising the level of efficacy.

Bandura (1997) pointed out that these sources of self efficacy rarely function independently of one another. Instead, one will judge his or her own abilities to achieve a given outcome based on the integration of the four efficacy expectations into his or her own belief system. Bandura (2000) also stated that the amount of effort one puts forth, how long one persists, and how one acts, thinks, and feels is based on the integration of the four efficacy expectations into his or her own belief system.

History and Development of Teacher Efficacy

According to Tschannen-Moran and Woolfolk Hoy (2001) early developments in measuring teacher efficacy were based on Rotter's locus of control theory from the late 1960's. In trying to assign meaning to the construct of teacher efficacy, Rand researchers developed two questions which determined if teachers believed student learning was more dependent on external or internal factors (Tschannen-Moran & Woolfolk Hoy). The Rand item number one stated, "When it comes right down to it, a teacher really can't do

much because most of student's motivation and performance depends on his or her home environment" (p. 784). This survey question is directly based on the external locus of control concept. The Rand item number two stated, "If I really try hard, I can get through to even the most difficult or unmotivated students" (p. 785). This survey question is more closely aligned with the internal locus of control concept. Teachers who tended to agree with item number two seemed to have a higher self efficacy and put a higher emphasis on internal control (Tschannen-Moran & Woolfolk Hoy).

Teacher efficacy was further developed in the late 1970's primarily based on the studies of Albert Bandura. Bandura (1977) referred to teacher efficacy as the teacher's beliefs in his/her abilities to bring about desired outcomes in student engagement and learning. Bandura (1977, 1997) also identified four sources of efficacy expectations. He referred to these as mastery experiences, physiological and emotional states, vicarious experiences, and social persuasion. Since that time, teacher efficacy has been related to student behavior, planning and organization, motivation, student efficacy, and student achievement (Tschannen-Moran & Woolfolk Hoy, 2001).

During the early 1980's Guskey developed an instrument with 30 items to measure Responsibility for Student Achievement (RSA). Guskey's instrument attempted to measure the amount of teacher-assumed responsibility for student success or failure (Tschannen-Moran & Woolfolk Hoy, 2001). Guskey (1988) compared scores from the RSA to the Rand items and found strong correlations between teacher efficacy and student success or failure. Guskey also reported that teachers were much more likely to assume credit for positive student results than their ability to prevent negative student results.

At about the same time Guskey was developing the RSA, Rose and Medway

(1981) were developing a measurement instrument which consisted of 28 items called the Teacher Locus of Control (TLC). This instrument attempted to have teachers choose between two competing explanations for student success or failure (Tschannen-Moran & Woolfolk Hoy, 2001). The measurement instrument relied heavily on the Rotter concept of internal and external control because each competing choice on the instrument was a choice for external or internal control. Rose and Medway found the TLC was a much better predictor of teacher efficacy than the original Rand questions.

Gibson and Dembo (1984) developed a 30 item measurement of teacher efficacy called the Teacher Efficacy Scale (TES). The TES was developed by incorporating the self-efficacy and outcome expectancy from Bandura's social cognitive theory (Gibson & Dembo). The TES is based on personal teacher efficacy (PTE) and general teacher efficacy (GTE) with its basis going back to the original Rand questions where the PTE relates more to internal control factors and the GTE relates more to the external control factors (Tschannen-Moran & Woolfolk Hoy, 2001). Tschannen-Moran and Woolfolk Hoy reported the Gibson and Dembo teacher efficacy instrument continued to be one of the most reliable measures of teacher efficacy with many subject matter modifications being made to the instrument through the years. Tschannen-Moran and Woolfolk Hoy also report that other researchers have used the Gibson and Dembo measurement tool as a basis for developing measurement instruments to measure teacher efficacy for science teaching, classroom management, and special education.

Over the years, many tools and scales have been developed to try to capture teacher efficacy and define its relationship to many various factors as previously mentioned. From these simple measures, teacher efficacy scales have grown and become more complex to include such scales as the Riggs and Enochs' (1990) Science Teaching

Efficacy Belief Instrument (STEBI), Roberts and Henson's (2000) Self-Efficacy Teaching and Knowledge Instrument for Science Teachers (SETAKIST), and Goddard et al.'s Collective Teacher Efficacy (CTE) instrument (Goddard et al., 2000; Tschannen-Moran & Woolfolk Hoy, 2001). These instruments will be discussed further later in this paper.

Measuring Science Teacher Efficacy

Since the idea of teacher efficacy was first developed, researchers have struggled with ways to make instruments to measure particular aspects of teacher efficacy valid and reliable (Coladarci & Fink, 1995; Goddard et al., 2000; Tschannen-Moran & Woolfolk Hoy, 2001). Riggs and Enochs (1990) developed the first science teacher specific instrument to measure teacher efficacy. Based on Bandura's (1977) social cognitive theory application to teacher efficacy, Riggs and Enochs' Science Teacher Efficacy Belief Instrument (STEBI) consisted of two dimensions called the personal science teaching efficacy (PSTE) and the science teaching outcome expectancy (STOE). Coladarci and Fink and Guskey and Passaro (1994) argued that the STEBI has poor construct validity and the reliability of the STOE portion has poor reliability.

In response to the problems encountered by past researchers in finding an instrument to measure science teacher efficacy, Roberts and Henson (2000) worked to develop a new instrument which would address the theoretical and methodological problems encountered by past researchers. The new instrument designed by Roberts and Henson is known as the Self-Efficacy and Knowledge Instrument for Science Teachers (SETAKIST). Roberts and Henson's SETAKIST uses two constructs to measure teacher efficacy, personal efficacy and knowledge efficacy.

The personal efficacy construct of the SETAKIST is very similar to the personal

efficacy construct of Guskey's (1984) TES and Riggs and Enochs' (1990) STEBI. The personal efficacy construct of the SETAKIST corresponds to statements 2, 4, 6, 8, 10, 12, 15, and 16. The SETAKIST survey instrument uses a 5 point Likert scale to rate responses. One statement from the personal efficacy construct is, "I do not feel I have the necessary skills to teach science." Another statement from personal efficacy construct is "I feel anxious when teaching science content that I have not taught before" (Roberts & Henson, 2000). Roberts and Henson felt the personal efficacy construct of the SETAKIST did not need major revision since previous studies by Guskey (1988) and Woolfolk and Hoy (1990) had shown the personal efficacy construct of the TES and STEBI on which the SETAKIST was based had proven to be both valid and reliable.

The knowledge efficacy construct of the SETAKIST is based on the work of Lee Shulman in the field of pedagogical content knowledge. According to Shulman (1986) pedagogical content knowledge is how a teacher can take the subject matter of the content and put it into an instructional lesson to transfer that knowledge to the learner. Shulman also pointed out that although a thorough knowledge of teaching theories and methods is important, the knowledge of the theories and methods is secondary to having a thorough knowledge of the content. Shulman also concluded that a teacher's mastery of content knowledge plays a huge role in how a teacher can convey content to the students through various learning activities. Thus, Roberts and Henson (2000) included questions on the SETAKIST to measure science content knowledge efficacy as one construct of their instrument. Statements 1, 3, 5, 7, 9, 11, 13, and 14 of the instrument measure knowledge efficacy.

In order to test the SETAKIST instrument, Roberts and Henson (2000) piloted the instrument with 274 science teachers. They chose to analyze the data using a

confirmatory factor analysis (CFA) which is typically used to test theories, rather than an exploratory factor analysis (EFA) which typically generates theories. Roberts and Henson did this because much of the instrument (personal efficacy) had already been shown to be valid and reliable. Roberts and Henson also tested the instrument against three other models to test for construct validity and concluded that the two-factor model they had developed produced the best fit of data of all models tested.

Measuring Collective Teacher Efficacy

Like individual teacher efficacy, collective efficacy also has its basis in Bandura's (1977) social cognitive theory. Also similarly to individual efficacy, collective efficacy influences decisions, thoughts, actions, and feelings, but collective efficacy measures these factors for an entire group (Bandura, 1997). According to Bandura collective efficacy can be defined as "a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainment" (p. 477). Bandura also argued that at the group level, the individuals of the group make judgments on their abilities based on the group's shared knowledge, skills, interactions, and the synergistic dynamics of their actions. England (2006) contended that these dynamics also influence the group's commitment to tasks, planning, goal setting, and level of effort exerted by the group.

According to England (2006) there are two basic ways to measure collective efficacy. One way is to collect the individual efficacy beliefs of each member of a group and put them together. The other way is to collect each group member's efficacy beliefs about the group as a whole. Bandura (1997) and England stated that because of the ever-changing dynamics among groups and the dependency on factors such as leadership skills, knowledge, and relationships among group members, the collective efficacy must

be a group-level attribute and a separate entity from a sum of each individual's efficacy. Thus, collective efficacy should be measured as a whole group and not from the aggregation of individual efficacy measures gathered from individual self efficacy instruments.

Bandura (1997) contended that there are four fundamental sources for individual efficacy--mastery experience, vicarious experience, social persuasion, and emotional arousal as discussed previously in this chapter. Goddard et al. (2000) tend to agree with those four fundamental sources, but add analysis of the teaching task and assessment of teaching competence to the list. Analysis of the teaching task refers to teachers assessing what will be needed to engage in successful teaching. At the school level this would include many factors such as ability or motivational level of the students, instructional supplies, facility constraints, community support, and administrational support. The assessment of teaching competence at the school level would include the faculty's beliefs in teaching skills, methods, experience, and their belief in their collective ability to help all children succeed (Goddard et al.).

Individual Teacher Efficacy and Student Achievement

John Ross conducted a study in 1992 in which 18 history teachers in Grades 7 and 8 were involved with implementing a new social studies curriculum. The teachers' self-efficacy was measured using the Gibson and Dembo (1984) teacher efficacy scale. The Gibson and Dembo teacher efficacy scale was used in order to consider the two types of teacher efficacy (personal teaching efficacy and general teaching efficacy). The logic of this methodology was also consistent with Bandura's (1997) distinction between one's expectations about one's ability to implement a strategy and one's expectations about the outcomes of those strategies. The 18 teachers also underwent staff development on the

new curriculum for 3 days, were given a variety of curriculum support materials, and had coaches available to them to help with developing the lessons for the students. Results from Ross' (1992) study indicated that a high correlation existed between personal teacher efficacy ($r=.72$, $p<.05$) and general teacher efficacy ($r=.84$, $p<.05$) as measured by the Gibson and Dembo individual teacher efficacy scale and the student achievement on post test social studies scores.

Ross (1992) found teacher demographics such as age, experience, level of degree, and race did not show any significant relationship with student achievement levels. The amount of contacts with other teachers in collaborative settings and the amount of work with coaches did show a positive relationship among teacher efficacy and student achievement. Ross also found teachers who frequently sought the principal's involvement in making curriculum decisions not only showed the lowest individual teacher efficacy, but also had the lowest student achievement.

Based on Ross' (1992) study, individual teacher efficacy did show a positive relationship with student achievement in social studies. Ross' study was also significant because of the relationship shown between teachers with low efficacy and those teachers' need for principal involvement. Therefore, these findings may suggest teachers who have a sense of being empowered and lack the need of principal involvement may actually have higher teacher efficacy and thus higher student achievement.

Other research is consistent with similar findings to Ross (1992). Many other studies have shown teachers with a high level of efficacy tend to have behavioral practices which lead to high student achievement in reading and mathematics (Ashton & Webb, 1986; Moore & Esselman, 1992; Watson, 1991). The abundance of research available on individual teacher efficacy and its positive influence on student achievement

has sparked a relatively new discussion on the outcome of collective teacher efficacy and student achievement.

Collective Teacher Efficacy and Student Achievement

Goddard et al. (2000) believed the collective efficacy of teachers in a school shapes the normative environment of a school; thus, making collective teacher efficacy an integral part of student achievement. This belief prompted a study by Goddard et al. to investigate the impact of collective efficacy on student achievement. In this study Goddard and his fellow researchers used their newly validated collective teacher efficacy instrument to measure collective efficacy rather than using aggregated individual teacher efficacy as was done in previous studies by Bandura in 1993. Because Bandura's studies indicated collective teacher efficacy had an even greater impact on student achievement than socioeconomic status, Goddard et al. hypothesized collective teacher efficacy as measured with their new instrument would also greatly impact student achievement. To complete their study, teachers at 47 elementary schools were given the collective teacher efficacy instrument and student achievement scores in reading and math were calculated for each school. Results from this study indicated that group competence and task analysis for each group of teachers from each school were highly related. Consequently, Goddard's Collective Teacher Efficacy Instrument was validated as a measure for both whole group collective efficacy, and also group competence and group task analysis. This study also showed that a positive correlation existed between collective teacher efficacy and student achievement. In fact, using a multilevel analysis indicated a one unit increase in the collective efficacy score translated to an average 8.62 point gain in math and an 8.49 point gain in reading. These point gains can also be shown to be an increase of 40% of a standard deviation (Goddard et al., 2000).

In a 2006 study by Diana England, the impact of collective efficacy on student achievement of fourth grade students in reading and math was considered. England's (2006) study also focused on the relationship between individual and collective efficacy. In this study, a 16-item version of the Gibson and Dembo (1984) Teacher Efficacy Scale (TES) instrument was used to gather data for individual teacher efficacy from 71 fourth grade teachers from various school districts in Northeast Ohio. The Gibson and Dembo version of the TES instrument was used to measure the two factors of personal teacher efficacy and general teacher efficacy as previously discussed in this chapter. To measure the collective teacher efficacy, the Collective Teacher Efficacy (CTE) instrument developed by Goddard et al. (2000) was used. To measure the student performance, the Ohio Fourth Grade Reading Achievement Test and the Ohio Fourth Grade Mathematics Proficiency Test scores were used (England). Along with gathering information from these three pieces, England also administered a questionnaire asking for teachers' gender, age, race, years of experience, highest level of education, and teaching assignment.

England's (2006) study indicated a link between teacher characteristics, individual and collective teacher efficacy, and student achievement in reading and mathematics for the schools studied in Northeast Ohio. These results also supported findings from previous studies by Goddard et al. (2000) and Bandura (1997). Indications from these three studies suggest that collective teacher efficacy can positively impact student achievement in both reading and mathematics.

In a study by Larrick (2004) the collective efficacy of teachers in seven designated low socioeconomic elementary schools in Northern Virginia was examined to see if differences in achievement existed between low and high collective efficacy schools and student achievement in reading, writing, and mathematics. As Larrick

pointed out in this study, achievement levels vary greatly, even among low socioeconomic schools. This fact provided the rationale for Larrick to look for a factor that played a greater role than socioeconomic status. Larrick administered the short form of the Collective Teacher Efficacy Instrument which consisted of 12 questions addressed to teachers at each of the seven selected schools during a regular faculty meeting that he attended. The short version of the Collective Teacher Efficacy Instrument was developed by Roger Goddard in 2001 and was an adaptation of the 21-item version developed by Goddard et al. in 2000. Larrick collected mean scores for reading, writing, and mathematics from Virginia's Standards of Learning (SOL) tests from each respective school. Larrick compared collective teacher efficacy scores for each school to achievement levels in reading, writing, and mathematics. Larrick also examined the two constructs of collective efficacy, group competence and group task analysis, from each school in comparison to achievement scores in reading, writing, and mathematics.

Larrick (2004) used t-tests to determine the relationship between collective efficacy as a whole, group competence, and group task analysis and student achievement for reading, writing, and mathematics for each school. Larrick found a significant increase in level of achievement for students in reading and math from schools where the faculty had higher levels of collective efficacy and a significantly lower level of student achievement in reading and math where the faculty had lower levels of collective efficacy. This particular study showed no significant relationship between the level of collective efficacy and student achievement in writing.

Building Collective Efficacy Within a School

According to Goddard (2001), Manthey (2006), and Brinson and Steiner (2007) building collective efficacy within a school begins with developing an empowered

faculty with strong leadership who can unite the group for a common cause. Each researcher also pointed out, however, that is no easy task.

Goddard (2001) explained the rationale for building collective efficacy within a school is very straight forward in that for the members of a school to believe their collective actions can make a difference, the members need the power to exercise collective agency. Goddard contended faculties should receive useful performance feedback and set small, achievable goals which can help develop collective efficacy through mastery experiences that enhance the group competence construct of collective efficacy.

Manthey (2006) suggested it is the imperative role of the school leader to lead in ways that promote mastery experiences for teachers. Setting small, attainable goals and then providing the coaching/mentoring, time, and resources to make these positive mastery experiences leads teachers in the direction to gain persistence in an effort to overcome difficulties and succeed. Manthey pointed out the coaching and mentoring process also provides for knowledge ecology where sharing wisdom throughout an organization keeps the knowledge base broader when individuals leave due to retirement, promotion, or other reasons. This process in itself builds collective efficacy according to Manthey. Manthey also suggests that when high levels of collective efficacy exist in a school, students are much more likely to develop their own sense of personal efficacy.

Brinson and Steiner (2007) provided four positive consequences for why school leaders should want to build strong collective efficacy within their schools. They pointed out that strong collective efficacy improves student performance, lessens the impact of low socioeconomic status, builds stronger parent/teacher relationships, and helps to create a work environment where teachers are more committed. Brinson and Steiner recognized

there is not a one size fits all approach to building collective efficacy within a school. They do, however, suggest four actions which can have a huge impact on the process. Like Manthey (2006), Brinson and Steiner suggested the school leader create opportunities for teachers to collaborate and share skills and experience so the knowledge ecology of the school remains high. Like Goddard (2001), Brinson and Steiner advocated accurate and actionable feedback on teacher performance evaluation and involving teachers in the school decision-making process are important components of building collective efficacy. Brinson and Steiner, however, also contended that vast opportunities for teachers to build instructional knowledge and skills are a must.

Garcia (2004) proposed collective efficacy in schools can also be enhanced by developing professional learning communities. Garcia supposed that professional learning communities can improve a school by providing an increase in teacher efficacy, providing a greater satisfaction of teachers with their work, and providing a greater collective responsibility for improving students' academic performance. Therefore, Garcia insinuated that positive development of professional learning communities in schools can increase the collective efficacy of the faculty and in turn increase the academic achievement of the students. Roland Barth (2006) also indicated these types of professional learning communities within schools build collegial relationship, which he argues is a major component of building a successful school.

Summary

This chapter has presented the need for improved achievement in high school science. As a basis for improving achievement this chapter has also provided a brief history of the studies of individual teacher efficacy and the relationship of efficacy to student achievement in the areas of reading, mathematics, and social studies at the

elementary and middle school levels. Research indicates that teacher efficacy does positively impact achievement in these areas; however, no studies have been done which address the impact of individual or collective teacher efficacy for high school science.

Based on the lack of study on the impact of teacher efficacy at the high school level and particularly in science, this study examined how collective teacher efficacy might impact science achievement. In particular, this study examined the collective efficacy of science teachers as a whole group, in terms of group competence, and in terms of group task analysis at four different high schools and determined the relationship between each of these constructs and end-of-course tests in biology, physical science, chemistry, and physics. The methodology for conducting this study will be further discussed in Chapter 3.

Chapter 3: Methodology

Introduction

This chapter will discuss the methods of research used to collect and analyze data for this study. The chapter will begin with an overview of the research site. The chapter will continue with a discussion of data collection instruments that were used. The chapter will conclude with procedures for how the study will be conducted as well as how the data will be analyzed.

Purpose of Study

The major purpose of this study was to determine the impact of collective science teacher efficacy on student achievement in science. In order to achieve the purpose of this study, the following questions provided the guiding framework:

1. What is the impact of collective teacher efficacy on student achievement on the tested North Carolina science curriculum?

2. What is the impact of group competence on student achievement on the tested North Carolina science curriculum?

3. What is the impact of group task analysis on student achievement on the tested North Carolina science curriculum?

4. Which construct of collective efficacy, group competence or group task analysis, impacts student achievement the most in the tested North Carolina science curriculum?

5. What differences, if any, exist among student achievement on the tested North Carolina science curriculum at each of the four high schools in relation to collective efficacy, group competence, and group task analysis?

Research Site

The school district selected for this study is located in rural Northwestern North Carolina. The district consists of four high schools with an average 696 students each in Grades 9-12. The school district is considered a low-wealth district in North Carolina's socioeconomic categorization of school systems. The school system also has a very low turnover rate for science teachers. Over the past 3 years, only three science teacher positions have been replaced. These three openings all occurred due to either retirement or promotion within the system. Data for the 2007-2008 school year were collected about student achievement for each of the tested science areas (physical science, biology, chemistry, and physics) for each four high schools by subject area, by school, by teacher, and by individual student scale scores at the school district's central office from the director of testing and student accountability. The Collective Teacher Efficacy Instrument, which is a type of survey, allowed the researcher to gather collective teacher efficacy data from science teachers at each school during district-wide, science teacher staff development programs beginning in September 2008.

Student Performance

Student performance for physical science, biology, chemistry, and physics for the past years has been measured by the North Carolina End-of-Course Testing Program sponsored by the North Carolina State Department of Public Instruction. These tests have been a part of the North Carolina Student Accountability Program since the late 1980's. Each of these tests has been shown to be both valid and reliable through rigorous processes of review, revision, and field testing (North Carolina Department of Public Instruction, 2007). Individual student scale scores in each subject (biology, physical science, chemistry, and physics) were collected for the 2007-2008 school year and

disaggregated by teacher and by school, as well as for the system as a whole. Average scale scores for each subject were then compared to the collective efficacy as a whole, as well as the two constructs of collective efficacy (group competence and group task analysis).

Collective Teacher Efficacy Instrument

In order to measure the collective science teacher efficacy at each of the four high schools, a survey instrument called the Collective Teacher Efficacy (CTE) instrument developed by Goddard et al. (2000) was used. The CTE instrument consists of 21 items that use a Likert-type response system. The original instrument developed by Goddard et al., and used in a study by England (2006), employed a 6-point Likert scale ranging from strongly disagree to strongly agree.

Goddard et al. (2000) found the internal reliability of the CTE instrument to be very high with an alpha equal to .96. Goddard et al. also tested for the validity of the instrument by asking participants to not only respond to the CTE instrument, but also to an individual teacher efficacy scale and a measure of teacher trust in colleagues. According to England (2006) the CTE instrument positively related to the aggregated teacher efficacy scales ($r=.54$, $p<.01$) and positively related to the measure of teacher trust in colleagues ($r=.62$, $p<.01$). This evidence supports the construct validity of the CTE instrument (England).

Survey items on the CTE instrument (Goddard et al., 2000) included statements about teachers believing every student can learn and teachers being confident they can motivate every student to learn. The CTE instrument not only measures the collective efficacy of the whole group surveyed, but it also measures the two constructs of collective efficacy, group competence and group task analysis. Group competence is

measured on the instrument through 13 items (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 17, 18, and 21). A sample group competence statement on the instrument is “Teachers in this school system have what it takes to get the children to learn” (Goddard et al., p. 476). The second construct, group task analysis, is measured through eight items (11, 12, 13, 14, 15, 16, 19, and 20). A sample group task analysis statement on the instrument is “Students in this school system just aren’t motivated to learn” (Goddard et al., p. 476). Six of the group competence items and four of the group task analysis items are scored in reverse, that is, a “1” on the Likert scale is scored as a “6” and a “2” is scored as a “5.” An example of a group task analysis item that would be scored in reverse is “The lack of instructional materials and supplies makes teaching very difficult” (Goddard et al., p. 476). Therefore, a sample group could have a collective efficacy as a whole group between 21 and 126. The group competence level could range between 13 and 78, while the group task analysis level could range between 8 and 48. The higher the score, the higher the level of efficacy that is present for each construct or as a whole group. These total scores for each construct were then averaged to determine an average score for each teacher for collective teacher efficacy, group competence, and group task analysis. The researcher attained prior permission to use the CTE instrument for this study from Dr. Roger Goddard, an affiliate with the University of Michigan. This permission is found in Appendix B, followed by a cover letter for the participants of the study in Appendix C. The CTE instrument used for this study can be found in Appendix A.

Procedures

This study employed a correlational research design using quantitative data analysis to draw conclusions. The whole group collective efficacy, group competence, and group task analysis served as the independent factors for this study. Student scale

scores for the subjects of physical science, biology, chemistry, and physics served as dependent factors. Before beginning this study, a completed application was submitted to the International Review Board to seek approval for this study. A personal meeting with the school district's superintendent, deputy superintendent, and high school principals took place before the study began to ensure that all stakeholders understood all procedures and instruments used in the study. A letter granting permission to complete the study from the superintendent was also obtained. This letter is found in Appendix D.

The researcher administered the CTE survey instrument to science teachers at the four high schools during regularly scheduled, district-wide staff development meetings beginning in September 2008. The survey instrument was labeled with a number assigned to each teacher's name; however, the researcher kept the information gathered in the strictest of confidence and only used it for data analysis purposes. Individual teacher responses were not released to the district administration or through this research project. The CTE instrument allowed the researcher to find the mean collective efficacy, the mean group competence, and the mean group task analysis for the science teachers at each high school. The individual teacher scores were also used in a correlation matrix with student scale scores for each subject area to determine correlations which would address the first three research questions. A multiple regression aided in addressing research question 4, whether group competence or group task analysis, if either, is a major contributor to collective efficacy and student achievement. As a descriptive part of the study, differences in collective efficacy, group competence and group task analysis among the schools were examined to address research question 5.

The director of testing and accountability for the school system provided individual student scale score data. The data represented were for the 2007-2008 school

year and were further subdivided by teacher and school to determine the mean scale scores for each teacher in each subject. These scores also became part of a correlation matrix with each teacher's scores on the CTE instrument to look for correlations that would address the first three research questions.

Data Analysis Procedures

Several statistical procedures aided to analyze the data gathered during this study. Individual student scale scores were gathered by teacher, by subject, and by school. A mean scale score for each tested subject area each teacher teaches was loaded into a data grid along with the specific teacher's collective efficacy score, group competence score, and group task analysis score. From the data grid, a correlational matrix enabled the researcher to look for relationships addressing the first three research questions:

1. What is the impact of collective teacher efficacy on student achievement on the tested North Carolina science curriculum?

2. What is the impact of group competence on student achievement on the tested North Carolina science curriculum?

3. What is the impact of group task analysis on student achievement on the tested North Carolina science curriculum?

A multiple regression provided a means to analyze data to determine a possible answer for the fourth research question:

4. Which construct of collective efficacy, group competence or group task analysis, impacts student achievement the most in the tested North Carolina science curriculum?

Descriptive statistics provided a means to analyze differences between each school's student achievement as measured by each mean scale score for each school's tested

subjects of physical science, biology, chemistry, and physics. This procedure addressed the fifth research question:

5. What differences, if any, exist among student achievement on the tested North Carolina science curriculum at each of the four high schools in relation to collective efficacy, group competence, and group task analysis?

Limitations

This study was limited by several factors. First, this study focused on four high schools in a rural, low wealth district in Northwestern North Carolina. Therefore, generalizations outside this area cannot be made. Second, this study focused only on science teacher perceptions of collective efficacy and did not account for variables throughout the entire school. Thirdly, this study was limited by using the North Carolina end-of-course data for biology, physical science, chemistry, and physics. Therefore, generalizations outside these parameters cannot be made. This study was also limited by the fact that the schools are average size schools for North Carolina (700 students), the number of science teachers at each high school was a limited number which was prohibitive to some methods of statistical analysis.

Summary

This chapter has explained how this study was conducted in order to determine the impact of collective science teacher efficacy on science achievement at the high school level. The chapter also provided information about the participants, the instruments used to gather data, procedures for gathering data, and procedures for analyzing the data.

Chapter 4: Analysis of Data

Purpose

The purpose of this study was to examine relationships among collective teacher efficacy (and its sub-constructs of group competence and group task analysis) and the North Carolina End-of-Course Test science scores in physical science, biology, chemistry, and physics. The study focused on these relationships at four high schools in a Northwestern North Carolina school district with an average student population in Grades 9-12 of ≈ 700. In these four high schools, 24 science teachers teach the primary core of all science course offerings (Earth science, physical science, biology, chemistry, physics, biology 2, chemistry 2, and anatomy). For the purposes of this study, however, only physical science, biology, chemistry, and physics were considered since they are the ones that have an end-of-course test that is a standardized test issued by the state of North Carolina. The others have teacher-made exams and are more subjective than the standardized tests issued by the state.

Research shows student achievement has been directly linked to collective teacher efficacy (Bandura, 1997; England, 2006; Goddard et al., 2000; Larrick, 2004). These studies primarily focused on reading, mathematics, and social studies at the elementary and middle school levels, however. This study focused on testing this theoretical assumption at the high school level in the specific area of science. To guide in this study, a survey instrument (Appendix A) developed by Goddard et al. was administered to the 24 science teachers of the four high schools during a district-wide staff development meeting in September of 2008. The results of this survey gave information about each teacher's collective efficacy, group competence, and group task analysis beliefs. Historical test data provided other needed information to conduct this study. The

district's testing and student accountability director assisted in collecting the historical test data. Statistical analysis on the collected data provided information to address the five following research questions:

1. What is the impact of collective teacher efficacy on student achievement on the tested North Carolina science curriculum?

2. What is the impact of group competence on student achievement on the tested North Carolina science curriculum?

3. What is the impact of group task analysis on student achievement on the tested North Carolina science curriculum?

4. Which construct of collective efficacy, group competence or group task analysis, impacts student achievement the most in the tested North Carolina science curriculum?

5. What differences, if any, exist among student achievement on the tested North Carolina science curriculum at each of the four high schools in relation to collective efficacy, group competence, and group task analysis?

The data analysis is outlined as follows. The first section (Section 1: Historical School Data), focuses on historical data collected in terms of the school system and each school. The second section (Section 2: Collective Teacher Efficacy Data), focuses on survey results for each science teacher. The third section (Section 3: Data Related to Research Questions), examines the data collected in relation to each of the guiding research questions.

Data Analysis

Section 1: Historical School Data

The following sets of data tables show the student achievement level in physical

science, biology, chemistry, and physics as a school district and will further break the data down in terms of student achievement by school and student achievement in each subject by teacher.

Table 2

Student Achievement in Physical Science, Biology, Chemistry, and Physics by School District: 2007-2008

Subject	Average Scale Scores	Number of Students Tested	Number at Level III or IV	Percent at Level III or IV
Physical Science	154.8	574	422	73.5
Biology	151.7	414	295	71.3
Chemistry	156.6	169	158	93.5
Physics	155.5	37	36	97.3

It should be noted that in this school district, all students are required to take physical science and biology, while chemistry and physics are elective courses. Biology is also a required course from the state of North Carolina and is also an exit standard for high school graduation, meaning that students must score a level III or IV in order to receive credit. According to this 2007-2008 school year data, 28.7% of students did not meet that exit standard.

Table 3

Student Achievement in Physical Science, Biology, Chemistry and Physics by School: 2007-2008

School	Subject	Average Scale Scores	Number of Students Tested	Number at Level III or IV	Percent at Level III or IV
A	Physical Science	153.07	44	28	63.6
	Biology	146.22	9	4	44.4
	Chemistry	155.31	29	26	89.7
	Physics	N/A	N/A	N/A	N/A
B	Physical Science	155.71	198	154	77.8
	Biology	151.23	189	128	67.7
	Chemistry	162.32	38	36	94.7
	Physics	152.06	18	17	94.4
C	Physical Science	152.55	165	108	65.5
	Biology	151.22	115	81	70.4
	Chemistry	154.44	61	58	95.1
	Physics	158.00	7	7	100.0
D	Physical Science	156.26	167	132	79.0
	Biology	153.69	101	82	81.2
	Chemistry	155.27	41	38	92.3
	Physics	159.08	12	12	100.0

Table 3 breaks the system-wide data down to the school level for each tested subject area. It should be noted that although School A is the smallest school in the district, limited data exists for both physical science and biology due to an administrative decision to change the year in which students would take given courses at this particular school. It should also be noted that School A did not offer physics due to only three students showing an interest in the course. These students were allowed to take the course at the local community college, however. In analyzing this set of historical data, one should also keep in mind that chemistry and physics are elective courses, while physical

science and biology are required courses.

The next four data tables show individual teacher scores from each respective high school for each tested subject area to allow for a closer look at data trends.

Table 4

Student Achievement at School A in Physical Science, Biology, Chemistry, and Physics by Individual Teacher: 2007-2008

Teacher	Subject	Average Scale Scores	Number of Students Tested	Number at Level III or IV	Percent at Level III or IV
1A	Physical Science	*			
	Biology	*			
	Chemistry	*			
	Physics	*			
2A	Physical Science	*			
	Biology	*			
	Chemistry	*			
	Physics	*			
3A	Physical Science	153.07	44	28	63.6
	Biology	*			
	Chemistry	155.31	29	26	89.7
	Physics	*			
4A	Physical Science	*			
	Biology	146.22	9	4	44.4
	Chemistry				
	Physics				
5A	Physical Science	*			
	Biology	*			
	Chemistry	*			
	Physics	*			

*Teacher did not teach this course.

Table 5

Student Achievement at School B in Physical Science, Biology, Chemistry, and Physics by Individual Teacher: 2007-2008

Teacher	Subject	Average Scale Scores	Number of Students Tested	Number at Level III or IV	Percent at Level III or IV
1B	Physical Science	154.25	134	99	73.9
	Biology	*			
	Chemistry	*			
	Physics	*			
2B	Physical Science	*			
	Biology	*			
	Chemistry	*			
	Physics	152.06	18	17	94.4
3B	Physical Science	*			
	Biology	152.81	79	60	75.9
	Chemistry	*			
	Physics	*			
4B	Physical Science	158.19	48	42	87.5
	Biology	*			
	Chemistry	*			
	Physics	*			
5B	Physical Science	160.44	16	14	87.5
	Biology	*			
	Chemistry	162.32	38	36	94.7
	Physics	*			
6B	Physical Science	*			
	Biology	146.15	41	18	43.9
	Chemistry	*			
	Physics	*			
7B	Physical Science	*			
	Biology	152.43	69	50	72.5
	Chemistry	*			
	Physics	*			
8B	Physical Science	*			
	Biology	*			
	Chemistry	*			
	Physics	*			

*Teacher did not teach this course.

Table 6

Student Achievement at School C in Physical Science, Biology, Chemistry, and Physics by Individual Teacher: 2007-2008

Teacher	Subject	Average Scale Scores	Number of Students Tested	Number at Level III or IV	Percent at Level III or IV
1C	Physical Science	153.35	23	16	69.6
	Biology	*			
	Chemistry	*			
	Physics	*			
2C	Physical Science	157.14	14	13	92.9
	Biology	152.23	44	34	77.3
	Chemistry	*			
	Physics	*			
3C	Physical Science	149.61	44	22	50.0
	Biology	*			
	Chemistry	*			
	Physics	*			
4C	Physical Science	153.64	59	43	72.9
	Biology	147.08	53	29	54.7
	Chemistry	*			
	Physics	*			
5C	Physical Science	151.80	25	15	60.0
	Biology	160.94	18	18	100.0
	Chemistry	154.44	61	58	95.1
	Physics	*			
6C	Physical Science	*			
	Biology	*			
	Chemistry	*			
	Physics	158.00	7	7	100.0

*Teacher did not teach this course.

Table 7

Student Achievement at School D in Physical Science, Biology, Chemistry, and Physics by Individual Teacher: 2007-2008

Teacher	Subject	Average Scale Scores	Number of Students Tested	Number at Level III or IV	Percent at Level III or IV
1D	Physical Science	159.17	65	57	87.7
	Biology	*			
	Chemistry	*			
	Physics	159.08	12	12	100.0
2D	Physical Science	*			
	Biology	152.49	81	63	77.8
	Chemistry	*			
	Physics	*			
3D	Physical Science	149.89	35	23	65.7
	Biology	*			
	Chemistry	*			
	Physics	*			
4D	Physical Science	156.78	67	53	79.1
	Biology	*			
	Chemistry	155.27	41	38	92.7
	Physics	*			
5D	Physical Science	*			
	Biology	158.55	20	19	95.0
	Chemistry	*			
	Physics	*			

*Teacher did not teach this course.

When analyzing the above data tables, several statements can be made that are noteworthy to the overall research project. School A has one teacher who taught the tested subjects of physical science and chemistry and one teacher who taught the tested area of biology (although one should also keep in mind the low numbers of students

tested based on an administrative decision to implement a varied sequencing of courses). Each school has only one teacher teaching the tested areas of chemistry and physics, with the exception of School A which did not offer physics in the 2007-2008 school year. Another fact that becomes apparent is of the 24 teachers in the four high schools, only 7 contributed to end-of-course test scores in more than one area. Teacher 3A, 5B and 4D contributed in terms of physical science and chemistry. Teachers 4C and 5C contributed in terms of physical science and biology. Teacher 1D contributed in terms of physical science and physics. Teacher 5C contributed in the three areas of physical science, biology, and chemistry. It should also be noted that teachers 1A, 2A, and 8B did not contribute to the tested areas of high school science because these teachers taught in the areas of Earth science, anatomy, biology 2, or chemistry 2, which are not part of the tested North Carolina Science Curriculum for high schools. Teacher 5A did not contribute to the tested areas of the North Carolina Science Curriculum because the teacher is a new teacher to the system for the 2008-2009 school year. This teacher replaced a prior science teacher at School A, who moved into another position in the school system during the summer of 2008. All of these teachers will be considered, however, when analyzing the collective teacher efficacy survey because all of the four high schools, as well as the district, encourage planning and working collaboratively. Therefore, these teachers do have a minor role in student outcomes in tested subject areas even though they may not actually teach a course in the tested North Carolina science curriculum.

Section 2: Collective Teacher Efficacy Data

Section 2 of the data analysis consists of reporting data gathered from the Collective Teacher Efficacy (CTE) instrument originally developed by Goddard et al.

(2000). The 24 science teachers involved with this study met at a district-wide staff development meeting in September 2008 to disaggregate science test data and work on strategies for improvement in weak areas as indicated by these test data. At the conclusion of this meeting, the researcher explained the procedures for completing the CTE survey instrument. All 24 teachers agreed to participate in the survey and left their results with the researcher prior to departing from the meeting. The following data tables show the results of the survey as disaggregated by the researcher. The CTE instrument is measured by a Likert scale ranging from 1 to 6 with a 1 being strongly disagree, 2 being moderately disagree, 3 being disagree slightly more than agree, 4 being agree slightly more than agree, 5 being moderately agree, and 6 being strongly agree. Statements 6, 7, 8, 9, 10, 13, 14, 19, 20, and 21 were designed to be reversed scored. These scores were reversed before data were entered into SPSS version 14.0 to calculate frequency tables. Since collective teacher efficacy is measured in terms of two constructs, group competence and group task analysis, Table 8 focuses on the frequencies of the group competence questions and Table 9 focuses on the frequencies of the group task analysis. The keys for Tables 8 and 9 are as follows:

S.D. = Strongly Disagree
M.D. = Moderately Disagree
Sl.D. = Disagree Slightly More Than Agree
Sl.A. = Agree Slightly More Than Disagree
M.A. = Moderately Agree
S.A. = Strongly Agree
N = Number of Valid Scores
Mean = Arithmetic Mean of Likert Responses
σ = Standard Deviation

Table 8

Frequency Table of Collective Teacher Efficacy Instrument Statements that Measure the Group Competence Construct of Collective Teacher Efficacy

Item #	S.D.	M.D.	Sl. D.	Sl. A.	M.A.	S.A.	N	Mean	σ
1	0	0	1	2	6	15	24	5.46	0.833
2	0	0	4	3	14	3	24	4.67	0.917
3	0	0	0	5	11	8	24	5.13	0.741
4	0	0	2	5	13	4	24	4.79	0.833
5	0	1	1	7	9	6	24	4.75	1.032
6	0	2	1	4	7	10	24	4.92	1.248
7	2	4	6	3	6	3	24	3.67	1.551
8	2	2	8	5	3	4	24	3.71	1.488
9	0	0	0	3	9	12	24	5.38	0.711
10	0	3	1	7	9	4	24	4.42	1.213
17	0	0	0	4	7	13	24	5.38	0.770
18	0	0	1	5	10	8	24	5.04	0.859
21	0	0	1	9	7	7	24	4.83	0.917

The results for the group competence construct of collective teacher efficacy yielded the results as reported above in Table 8. All participants responded to each question as can be noted by the number of valid scores for each statement being 24. With the strongly agree response carrying the highest weight of 6, the statements where the response means are the closest to 6 are deemed as the particular areas where participants feel they have the highest level of efficacy. Statements 1, 3, 9, 17, and 18 all had a mean score of greater than 5 suggesting that for issues addressed by these statements, the participants had a high level of collective efficacy as measured by the group competence construct. These statements are as follows:

1. Teachers in this school have what it takes to get the children to learn.

3. If a child doesn’t learn something the first time, teachers will try another way.

9. Teachers here don’t have the skills needed to produce meaningful student learning.

17. Teachers here are well prepared to teach the subjects they are assigned to teach.

18. Teachers in this school are skilled in various methods of teaching.

One should keep in mind that statement 9 is one of the reversed scored items, thus participants responding with strongly disagree or moderately disagree would be scored as a 6 or 5 respectively. It should also be noted statements 3, 9, and 17 have the lowest standard deviation. The participants having the highest scores in response to items 3, 9, and 17 indicated the participants commonly feel the strongest about these particular areas.

These data also show participants scored the lowest on statements 7 and 8. These statements are reversed scored items. These are also the only two statements of the group competence portion of the CTE instrument to have responses in all 6 Likert response columns. This broad range of responses not only caused the mean score for statements 7 and 8 to be 3.67 and 3.71, respectively, but it also generated standard deviations of 1.551 and 1.488 respectively. These statements are as follows:

7. Teachers here need more training to know how to deal with these students.
8. Teachers in this school think there are some students that no one can reach.

Table 9

Frequency Table of Collective Teacher Efficacy Instrument Statements that Measure the Group Task Analysis Construct of Collective Teacher Efficacy

Item #	S.D.	M.D.	Sl.D.	Sl.A.	M.A.	S.A.	N	Mean	Σ
11	4	6	10	4	0	0	24	2.58	0.974
12	9	5	7	3	0	0	24	2.17	1.090
13	6	7	5	3	3	0	24	2.58	1.349
14	1	2	9	6	4	2	24	3.67	1.239
15	0	0	3	7	9	5	24	4.67	0.963
16	1	6	11	2	4	0	24	3.08	1.100
19	0	0	0	2	10	12	24	5.42	0.654
20	0	3	8	6	3	4	24	3.88	1.296

The results for the group task analysis construct of collective teacher efficacy yielded the results as reported in Table 9. Statements 13, 14, 19, and 20 were reversed scored items. These results were reversed prior to entering data into SPSS version 14.0 for analysis. Again, as was the case with the group competence construct of collective efficacy, Likert scale scores closer to 6 are indicative of the levels of highest group task analysis. The two statements with the highest levels of collective teacher efficacy as measured by the group task analysis construct were statements 15 and 19 with a mean of 4.67 and 5.42, respectively. These two statements also yielded the lowest standard deviations (0.963 and 0.654 respectively) suggesting the highest level of consensus among the entire group of participants. These statements are:

15. The quality of school facilities here really facilitates the teaching and learning process.

19. Learning is more difficult in this school because students are worried about their safety.

It should be noted here that each of the four high schools has undergone major

renovations and in some cases completely new facilities are in place. These facilities also include security doors and much emphasis has been placed on safety procedures throughout the school district. Each of the high schools also has a full-time school resource officer on campus.

Statements 11, 12, and 13 had the overall lowest scores with the overall means less than 2.60, which shows a very low level of collective efficacy among the group for the areas described by those statements. Statement 11 had a standard deviation of 0.974 and statement 12 had a standard deviation of 1.090 which suggested a relatively strong consensus of the group of participants regarding these two items in particular. Statements 11, 12, and 13 are as follows:

11. These students come to school ready to learn.

12. Home life provides so many advantages they are bound to learn.

13. The lack of instructional materials and supplies makes teaching very difficult.

The Collective Teacher Efficacy (CTE) Instrument Participant Results for Each Statement, found in Appendix E, shows the actual responses of each teacher participant with each statement labeled as Q. Each teacher number is also listed for each high school, i.e. teacher 1A is teacher 1 from school A. These scores represent what each teacher participant marked on the CTE instrument with the reversed scored items (6, 7, 8, 9, 10, 13, 14, 19, 20, and 21) already reversed in the responses indicated above. Table 10 below depicts each participant's actual collective teacher efficacy (CTE) score as well as the scores for the two constructs of collective efficacy, group competence (GC) and group task analysis (GTA).

Table 10

Individual Teacher's Total Collective Efficacy, Group Competence, and Group Task Analysis Scores Based on Responses on The Collective Teacher Efficacy Instrument

Teacher #	CTE	GC	GTA
1A	99	74	25
2A	88	66	22
3A	72	49	23
4A	74	50	24
5A	88	62	26
1B	105	66	39
2B	72	45	27
3B	99	63	36
4B	104	69	35
5B	109	76	33
6B	82	57	25
7B	86	58	28
8B	99	68	31
1C	64	40	24
2C	96	66	30
3C	86	69	17
4C	86	61	25
5C	96	70	26
6C	75	47	28
1D	96	66	30
2D	98	70	28
3D	89	61	27
4D	100	71	29
5D	101	67	34

Upon completing a general descriptive statistical analysis of the teachers' individual scores for collective efficacy (CTE), group competence (GC), and group task analysis (GTA), the maximum and minimum scores for each category, the mean score for each category, and the standard deviation for each category can easily be found. When analyzing the CTE scores, the maximum score was found to be 109 and the minimum score was 64. The maximum score possible for this section was 126 due to the 6-point

Likert scale for the CTE instrument and 21 statements and the lowest possible minimum score was 21. The mean score for the CTE scores was 90.17 with a standard deviation of 12.06. For the GC construct portion of the instrument, the maximum score was found to be 76 and the minimum score was 40. The maximum possible score for this portion was 78 and the lowest minimum score was 13 based on the fact that this section contained 13 response statements on the 6-point Likert scale. The mean score for the GC portion was 62.13 with a standard deviation of 9.62. For the GTA construct portion of the instrument, the maximum score was found to be 39 and the minimum score was 17. The maximum possible score for this portion was 48 and the lowest possible score was 8 based on the fact that the GTA portion of the CTE instrument contained 8 response statements on the 6-point Likert scale. The mean score for the GTA portion was 28.00 with a standard deviation of 4.95. This information can also be found in Table 11 below.

It should also be noted that School B had 3 teachers with CTE scores of greater than 100. School B also had teachers with the maximum CTE score (5B-109), the maximum GC score (5B-76), and the maximum GTA score (1B-39). School D also had two teachers with CTE scores of greater than 100. By contrast, School A and School C did not have any CTE scores higher than 99 and School C had teachers with the minimum CTE score (1C-64), the minimum GC score (1C-40), and the minimum GTA score (3C-17).

Table 11

Descriptive Statistical Analysis of Collective Teacher Efficacy Scores, Group Competence Scores, and Group Task Analysis Scores as Measured by the Collective Teacher Efficacy Instrument

	Maximum Score	Minimum Score	Mean Score	Standard Deviation
CTE	109	64	90.17	12.06
GC	76	40	62.13	9.62
GTA	39	17	28.00	4.95

Section 3: Data Related to Research Questions

Section 3 of the data analysis focuses on combining data found in sections 1 and 2 in order to address the research questions which have provided the guiding framework for this study. To address research question 1, “What is the impact of collective teacher efficacy on student achievement on the tested North Carolina science curriculum?” a Pearson’s Bivariate correlation was conducted. One correlation was calculated using the number of teachers directly contributing to the scores of physical science, biology, chemistry, and physics. Another correlation was calculated by weighting the cases according to the number of students tested in each tested science subject area. Tables 12 and 13 show the results of each of the Pearson’s Bivariate correlations.

Table 12

Unweighted Pearson's Bivariate Correlations Among Collective Teacher Efficacy and Each Subject of the Tested North Carolina Science Curriculum (N = Number of Teachers Directly Contributing)

		CTE
Physical Science	Pearson Correlation	0.550
	Sig. (2-tailed)	0.074
	N =	12
Biology	Pearson Correlation	0.768*
	Sig. (2-tailed)	0.014
	N =	9
Chemistry	Pearson Correlation	0.583
	Sig. (2-tailed)	0.417
	N =	4
Physics	Pearson Correlation	0.705
	Sig. (2-tailed)	0.491
	N =	3

*p<0.05

Table 13

Weighted Pearson's Bivariate Correlations Among Collective Teacher Efficacy and Each Subject of the Tested North Carolina Science Curriculum (N = Number of Students Tested)

		CTE
Physical Science	Pearson Correlation	0.469**
	Sig. (2-tailed)	0
	N =	574
Biology	Pearson Correlation	0.696**
	Sig. (2-tailed)	0
	N =	414
Chemistry	Pearson Correlation	0.560**
	Sig. (2-tailed)	0
	N =	169
Physics	Pearson Correlation	0.816**
	Sig. (2-tailed)	0
	N =	37

**p<0.01

Based on the correlations presented in Table 12 each tested subject area shows at least a moderate correlation to collective teacher efficacy. Biology actually shows a significant correlation to collective teacher efficacy (r = 0.768, $p<0.05$). The other correlations are not considered significant due to the small number of N in each case. However, when the cases are weighted to consider the number of students tested and influenced by the instructors for each class, significant correlations can be found in each tested subject area as indicated in Table 13. The following correlations can be found among each tested science subject area and collective teacher efficacy: physical science (r = 0.469, $p<0.01$), biology (r = 0.696, $p<0.01$), chemistry (r = 0.560, $p<0.01$), and physics

(r = 0.816, *p*<0.01).

To address research question 2, “What is the impact of group competence on student achievement on the tested North Carolina science curriculum?” a Pearson’s Bivariate correlation was conducted to find any correlations which might exist among each of the tested subject areas (physical science, biology, chemistry, and physics) and the group competence construct of collective efficacy. One correlation was conducted using the number of teachers directly involved with classes in each subject area. Another correlation was conducted by weighting the cases to reflect the number of students involved in taking the end of course tests in each subject area. These results are reflected in Tables 14 and 15 respectively.

Table 14

Unweighted Pearson’s Bivariate Correlations Among Group Competence and Each Subject of the Tested North Carolina Science Curriculum (N = Number of Teachers Directly Contributing)

		GC
Physical Science	Pearson Correlation	0.372
	Sig. (2-tailed)	0.27
	N =	12
Biology	Pearson Correlation	0.765*
	Sig. (2-tailed)	0.016
	N =	9
Chemistry	Pearson Correlation	0.48
	Sig. (2-tailed)	0.519
	N =	4
Physics	Pearson Correlation	0.842
	Sig. (2-tailed)	0.352
	N =	3

*p<0.05

Table 15

Weighted Pearson's Bivariate Correlations Among Group Competence and Each Subject of the Tested North Carolina Science Curriculum (N = Number of Students Tested)

		GC
Physical Science	Pearson Correlation	0.333**
	Sig. (2-tailed)	0
	N =	574
Biology	Pearson Correlation	0.598**
	Sig. (2-tailed)	0
	N =	414
Chemistry	Pearson Correlation	0.429**
	Sig. (2-tailed)	0
	N =	169
Physics	Pearson Correlation	0.801**
	Sig. (2-tailed)	0
	N =	37

*p<0.01

Based on the data from Table 14, positive correlations exist between each tested subject area and group competence. The strongest correlations exist between group competence and physics and group competence and biology. The group competence and biology correlation is actually a significant correlation (r = .765, $p<0.05$). None of the other correlations indicated in Table 14 are significant correlations due to the low number of sample cases for N. When the cases are weighted to reflect the number of students tested, however, a significant correlation exists between each tested subject area and group competence as indicated in Table 15. The following correlations can be found among each of the tested science subject areas and the group competence construct:

physical science (r = .333, *p*<0.01), biology (r = .598, *p*<0.01), chemistry (r = .429, *p*<0.01), and physics (r = .801, *p*<0.01).

To address research question 3, “What is the impact of group task analysis on student achievement on the tested North Carolina science curriculum?” the researcher used a Pearson’s Bivariate correlation to look for relationships that may exist. One correlation was conducted to correlate the group task analysis construct to physical science, biology, chemistry, and physics using N as the number of teachers directly involved with teaching these specific classes as indicated in Table 16. Another correlation was conducted to correlate the group task analysis construct to physical science, biology, chemistry, and physics by weighting the cases and using N as the number of students tested in each of the subject areas as indicated in Table 17.

Table 16

Unweighted Pearson’s Bivariate Correlations Among Group Task Analysis and Each Subject of the Tested North Carolina Science Curriculum (N = Number of Teachers Directly Contributing)

		GTA
Physical Science	Pearson Correlation	0.642*
	Sig. (2-tailed)	0.029
	N =	12
Biology	Pearson Correlation	0.479
	Sig. (2-tailed)	0.176
	N =	9
Chemistry	Pearson Correlation	0.812
	Sig. (2-tailed)	0.188
	N =	4
Physics	Pearson Correlation	0.842
	Sig. (2-tailed)	0.352
	N =	3

*p<0.05

Table 17

Weighted Pearson's Bivariate Correlations Among Group Task Analysis and Each Subject of the Tested North Carolina Science Curriculum (N = Number of Students Tested)

		GTA
Physical Science	Pearson Correlation	0.453**
	Sig. (2-tailed)	0
	N =	574
Biology	Pearson Correlation	0.487**
	Sig. (2-tailed)	0
	N =	414
Chemistry	Pearson Correlation	0.826**
	Sig. (2-tailed)	0
	N =	169
Physics	Pearson Correlation	0.906**
	Sig. (2-tailed)	0
	N =	37

**$p<0.01$

Based on the data represented in Table 16, the researcher found moderate to strong correlations existed between the construct of group task analysis and each of the tested areas of physical science, biology, chemistry, and physics. Due to the low numbers for N (number of teachers directly involved with specified courses) only the physical science correlation is significant (r = .642, $p<0.05$). However, when the cases are weighted to include the number of students involved testing in each subject area as indicated in Table 17, each correlation is significant. The correlations between group task analysis and physical science and group task analysis and biology show a moderate correlation of r = .453, $p<0.01$ and r = .487, $p<0.01$, respectively. Chemistry shows a

strong correlation to group task analysis (r = .826, *p*<0.01). Physics also shows a strong correlation to group task analysis (r = .906, *p*<0.01).

A stepwise regression generated data results to address research question 4, "Which construct of collective efficacy, group competence or group task analysis, impacts student achievement the most in the tested North Carolina science curriculum?" The cases were weighted according to the number of students tested for each of the tested courses of physical science, biology, chemistry, and physics. For each calculated case, the tested science subject was entered as the dependent variable and the constructs of group competence and group task analysis were listed as the independent variables. Based on the results given when data were calculated using the SPSS version 14.0 statistical software, Table 18 was created.

Table 18

Stepwise Regression Analysis for Determining Which Construct of Collective Efficacy, Group Competence or Group Task Analysis, Had a Greater Impact on the Tested North Carolina Science Curriculum

		Physical Science			Biology	
Predictor	B	β	p-value	B	β	p-value
GC	0.081	0.207	0.00	0.366	0.513	0.00
GTA	0.176	0.385	0.00	0.334	0.367	0.00

		Chemistry			Physics	
Predictor	B	β	p-value	B	β	p-value
GC	-0.241	-0.691	0.00	-0.720	-2.074	0.00
GTA	1.273	1.385	0.00	7.38	2.937	0.00

The regression results for the predictors of group competence (GC) and group task analysis (GTA) to student achievement on the tested North Carolina science curriculum are shown in Table 18. One can observe from the data table that for each

tested subject, each predictor is statistically significant at the $p<0.000$ level. However, when looking at specific subjects, one predictor becomes more significant than the other in each case. When considering physical science as the dependent variable (γ' = physical science), the regression equation, γ' = 144.265 + (.176)GTA + (.081)GC, suggests group task analysis is the most contributing factor for student achievement (β = .385, $p<0.000$). The adjusted R^2 value for the physical science consideration was .241 with the significance level at 0.000. When considering biology as the dependent variable (γ' = biology), the regression equation, γ' = 118.794 + (.334)GTA + (.366)GC, suggests group competence is the most contributing factor for student achievement (β = .513, $p<0.000$). The adjusted R^2 value for the biology consideration was .483 with the significance level at 0.000. When considering chemistry as the dependent variable (γ' = chemistry), the regression equation, γ' = 137.619 + (1.273)GTA + (-.241)GC, suggests group task analysis is the most contributing factor for student achievement (β = 1.385, $p<0.000$). The adjusted R^2 value for the chemistry consideration was .846 with the significance level at 0.000. When considering physics the dependent variable (γ' = physics), the regression equation, γ' = -14.800 + (7.380)GTA + (-.241)GC, suggests group task analysis is the most contributing factor for student achievement (β = 2.937, $p<0.000$). The adjusted R^2 value for the physics consideration was 1.000 with the significance level at 0.000. Therefore, this data suggests group task analysis was the most contributing predictor for physical science, chemistry, and physics, while group competence was the most contributing factor for biology.

A number of descriptive statistical methods were employed to address research question 5, “What differences, if any, exist among student achievement on the tested North Carolina science curriculum at each of the four high schools in relation to

collective efficacy, group competence, and group task analysis?" Due to the low number of teachers involved at each high school, other statistical methods were not deemed as being valid. Tables 19, 20, 21, and 22 below present collective efficacy data and student achievement data aligned with the contributing teacher.

Table 19

School A Collective Efficacy Data and Student Achievement Data

Teacher #	CTE	GC	GTA	Physical science	Biology	Chemistry	Physics
1A	99	74	25				
2A	88	66	22				
3A	72	49	23	153.07		155.31	
4A	74	50	24		146.22		
5A	88	62	26				
Mean	84.2	60	24	153.07*	146.22*	155.31*	N/A

*Mean weighted based on the number of students tested at school

Table 20

School B Collective Efficacy Data and Student Achievement Data

Teacher #	CTE	GC	GTA	Physical science	Biology	Chemistry	Physics
1B	105	66	39	154.25			
2B	72	45	27				152.06
3B	99	63	36		152.81		
4B	104	69	35	158.19			
5B	109	76	33	160.44		162.32	
6B	82	57	25		146.15		
7B	86	58	28		152.43		
8B	99	68	31				
Means	94.5	63	31.8	155.71*	151.23*	162.32*	152.06*

*Mean weighted based on the number of students tested at school

Table 21

School C Collective Efficacy Data and Student Achievement Data

Teacher #	CTE	GC	GTA	Physical science	Biology	Chemistry	Physics
1C	64	40	24	153.35			
2C	96	66	30	157.14	152.23		
3C	86	69	17	149.61			
4C	86	61	25	153.64	147.08		
5C	96	70	26	151.80	160.94	154.44	
6C	75	47	28				158.00
Mean	83.8	59	25	152.55*	151.22*	154.44*	158.00*

*Mean weighted based on the number of students tested at school

Table 22

School D Collective Efficacy Data and Student Achievement Data

Teacher #	CTE	GC	GTA	Physical science	Biology	Chemistry	Physics
1D	96	66	30	159.17			159.08
2D	98	70	28		152.49		
3D	89	61	27	149.89			
4D	100	71	29	156.78		155.27	
5D	101	67	34		158.55		
Mean	96.8	67	29.6	156.26*	153.09*	155.27*	159.08*

*Mean weighted based on the number of students tested at school

Based on the data presented from Tables 19-22, several observations can be made. School D had the highest overall collective teacher efficacy (96.8) as well as the highest group competence score (67). School D had the second highest group task analysis score (29.6). School B had the next highest overall collective teacher efficacy (94.5), the second highest group competence score (63), and the highest group task analysis score (31.8). School A had the second lowest overall collective teacher efficacy score (84.2), the second lowest group competence score (60), and the lowest group task analysis score (24). School C had the lowest overall collective efficacy score (83.8), the lowest group competence score (59), and the second lowest group task analysis score (25).

Another observation that can be made based on the data from Tables 20-23 involves student achievement data at each of the four high schools. While School D had the highest overall collective efficacy score and the highest group competence score, it also had the highest student achievement in physical science (156.26), biology (153.09), and physics (159.08). While School B had the second highest overall collective efficacy score and the highest group task analysis score, it also had the highest student achievement in chemistry (162.32). School B also had the second highest student achievement in physical science (155.71) and biology (151.23). School A, having the second lowest overall collective teacher efficacy score and the lowest group task analysis score, also had the lowest student achievement in biology (146.22) and the second lowest student achievement in physical science (153.07). School A did have the second highest student achievement in chemistry (155.31) as compared to the third highest at School D (155.27). School A did not offer physics during the 2007-2008 school year due to the low number of students registered for the course. School C had the lowest overall collective efficacy score as well as the lowest group competence score. School C also had the lowest student achievement in physical science (152.55) and the lowest student achievement in chemistry (154.44). School C had the second lowest student achievement in biology (151.22). School C did have the second highest student achievement in physics (158.00).

Summary

This chapter has analyzed the results of this study in 3 distinct phases. Section 1 focused on historical test data from the 2007-2008 school year for the school district particular to this study. Section 2 focused on analyzing data gathered through the use of the Collective Teacher Efficacy instrument developed by Goddard et al. (2000). Section 3

merged data from section 1 and section 2 in order to address the five research questions guiding this study.

Section 1 presented historical test data for the physical science, biology, chemistry, and physics end-of-course tests for the school district as a whole and included not only the scores for each tested area, but the number of students tested and the number and percentage of those students who were proficient (scored a level III or IV) on the tests. These data were further broken down by individual schools and individual teachers to provide a better understanding of the number of students tested at each school as well as the teachers who directly contributed to the scores for each tested subject.

Section 2 analyzed the results of the Collective Teacher Efficacy Instrument. When analyzing the group competence portion of the instrument, the researcher made two direct observations from teacher responses. The first observation of the data suggested teachers as a whole in this district were confident they had skills for meaningful teaching and were confident in the subject matter they taught. The second observation of the data suggested teachers as a whole felt unprepared to help students who were not motivated or those students typically deemed hard to reach.

When analyzing the group task analysis portion of the instrument, the researcher was able to make two direct observations from teacher responses. The first observation of the data suggested teachers feel that school facilities are up to par for teaching and learning and that students feel safe in the school facilities. The second observation of the data suggested teachers feel their students come to school unprepared and the students' home lives do not contribute to student achievement.

Section 3 related the historical data from section 1 to the CTE instrument data from section 2 to address the research questions guiding this project. To address

questions 1-3, Pearson's Bivariate correlations were conducted by weighting the cases by the number of students tested in each subject area (physical science, biology, chemistry, and physics). The results yielded significant correlations at the $p<0.01$ level between collective teacher efficacy, group competence, and group task analysis as correlated with each of the tested subjects. A regression analysis aided in determining which construct of collective efficacy, group competence or group task analysis, was the most contributing factor for student achievement in each tested subject area. Results indicated group competence was the main contributing factor for biology, while group task analysis was the main contributing factor for student achievement in physical science, chemistry, and physics. In the last portion of section 3, the researcher used simple descriptive statistics to determine if any differences existed among student achievement at the four high schools in relation to collective teacher efficacy, group competence, and group task analysis. Results suggested at School B and School D, where teachers had the highest levels of overall collective teacher efficacy, group competence, and group task analysis, students had the highest overall achievement in each tested subject area.

Chapter 5: Conclusions

Introduction

The major purpose of this study was to determine the impact of collective science teacher efficacy on student achievement in high school science. The relationship between collective teacher efficacy and student achievement has been well documented by other researchers in the areas of elementary and middle school reading, math, and social studies (England, 2006; Goddard et al., 2000; Larrick, 2004; Schwarzer et al., 1999). Because no studies had been done at the high school level, the researcher felt the need existed to explore this relationship between collective teacher efficacy and student achievement in science at the high school level. In order to measure the collective teacher efficacy of the science teachers at each of the four high schools considered in this study, a survey instrument called the Collective Teacher Efficacy (CTE) instrument developed by Goddard et al. (2000) was used. This instrument may be found in Appendix A.

The study was designed by the use of a point-in-time quantitative correlational study using a non-experimental approach. According to the research of Goddard et al. (2000), collective teacher efficacy can be further broken down into two constructs, group competence and group task analysis. For this study, the researcher compared end-of-course test scores for the tested science areas of physical science, biology, chemistry, and physics to the participants' collective teacher efficacy scores, group competence scores, and group task analysis scores using a correlation matrix. A regression analysis was used to determine whether the group competence construct, which relates to internal locus of control, or group task analysis, which relates to external locus of control, had the most impact on each of the tested science subjects. The researcher used a brief statistical analysis to also examine differences in student achievement, collective teacher efficacy,

group competence, and group task analysis among the four high schools involved with the study.

In order to guide this research study, five questions were considered:

1. What is the impact of collective teacher efficacy on student achievement on the tested North Carolina science curriculum?

2. What is the impact of group competence on student achievement on the tested North Carolina science curriculum?

3. What is the impact of group task analysis on student achievement on the tested North Carolina science curriculum?

4. Which construct of collective efficacy, group competence or group task analysis, impacts student achievement the most in the tested North Carolina science curriculum?

5. What differences, if any, exist among student achievement on the tested North Carolina science curriculum at each of the four high schools in relation to collective efficacy, group competence, and group task analysis?

Questions 1, 2, and 3 were explored by using descriptive statistics along with Pearson's Bivariate correlations. Question 4 was examined using a stepwise regression analysis where group competence and group task analysis were used as predictors for each of the tested science subjects. Question 5 was probed using several descriptive statistical procedures to make general comparisons due to the low number of teachers involved in the study. The results gathered from addressing each of the research questions in Chapter 4, led to the following implications.

Implications of the Findings

When analyzing historical school data for the four high schools involved in this

study, it is interesting to point out that physical science and biology had only 73.5% and 71.3%, respectively, of students scoring proficient on the end-of-course tests. Chemistry and physics had 93.5% and 97.3%, respectively, of students scoring proficient on the end-of-course tests. Although chemistry and physics are elective courses and students typically should do better, physical science and biology pose a huge concern because with these scores, 26.5% of physical science students and 28.7% of biology students are not receiving needed credit for graduation requirements. It was also noticeable from the data analysis the two high schools that had the highest collective science teacher efficacy levels also had the highest student achievement levels in the areas of physical science and biology. This finding suggests the schools with the highest level of collective science teacher efficacy were better able to meet student needs in the subjects required for graduation.

The results obtained from the CTE instrument (Appendix A) reveal teachers' attitudes about their teaching and about students' learning. It should be noted that items 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 17, 18, and 21 relate to the group competence (internal locus of control) and items 11, 12, 13, 14, 15, 16, 19, and 20 relate to the group task analysis (external locus of control). Having the highest scores for items 3, 9, and 17 suggested the participants having the highest levels of collective efficacy, as measured by the group competence construct, in such areas as being able to reteach concepts as necessary, having the skills needed to make learning meaningful, and being well prepared to teach their subject areas. Items 7 and 8 had the lowest scores of collective efficacy, as measured by the group competence construct. Low scores for these items suggested that teachers felt they need more training to help reach students who have given up on their own learning. It would also suggest that teachers felt they needed more training on how

to reach students who are typically classified as hard to reach students. In terms of measuring group task analysis (external locus of control) teachers scored the highest on items 15 and 19, which suggested they felt safe and their students felt safe in their schools and that school facilities were adequate for learning. The lowest scores for group task analysis were on items 11, 12, and 13. The low scores for these statements suggested the participants believed their students do not come to school ready to learn, their students' home lives do not provide advantages to aid in learning, and that a lack of instructional materials makes teaching difficult. Statement 16, "The opportunities in this community help ensure that these students will learn" also provided some insight into the group's collective efficacy. The fact that 18 of 24 participants responded negatively to that statement suggested the participants do not feel that opportunities abound for students in their respective communities to help build learning opportunities.

Based on the Pearson's Bivariate correlations the researcher conducted, it was quite evident that strong correlations existed between collective teacher efficacy and each of the tested science subject areas. Strong correlations also existed between the two constructs of collective teacher efficacy, group competence and group task analysis, and the tested science subject areas. This finding was consistent with the research completed at the elementary and middle school levels (England, 2006; Goddard et al., 2000; Larrick, 2004; Schwarzer et al., 1999). These correlations suggested that collective teacher efficacy does have a large impact on student achievement at the high school level and particularly in the tested science subject areas of physical science, biology, chemistry, and physics. Specifically, the group task analysis construct of collective teacher efficacy, which reflects the external locus of control, was found to be the most contributing factor towards student achievement in physical science, chemistry, and physics upon

completion of a stepwise regression analysis. The construct of group competence, which reflects the internal locus of control, was found to be the most contributing factor towards student achievement in biology after completion of a stepwise regression analysis. After exploring these most contributing factors for each class, it became evident that group task analysis played a much larger role in the physical sciences, while group competence played a much larger role in the life science area. Based on Rotter's ideas of locus of control and the extension of that idea into collective teacher efficacy by Goddard et al. (2000), one may suggest teachers with the highest student achievement in the physical sciences are better able to overcome the external influences in order to improve student achievement, while teachers with the highest student achievement in the life sciences are better able to overcome the internal influences in order to improve student achievement. Goddard et al. suggested the internal influences were such things as getting through to difficult students, motivating students to perform, not giving up on a student, and the teachers' knowledge and skill in the area being taught. They also suggested the external influences were such things as the students' home lives, school facilities, instructional supplies, and community educational opportunities.

After the researcher completed some basic statistical analysis to compare schools and teachers, Schools B and D were found to have the highest collective teacher efficacy scores, as well as the highest scores for the group competence construct and group task analysis construct. These schools also had the highest levels of student achievement in each of the tested subjects (physical science, biology, chemistry, and physics). This evidence suggested collective teacher efficacy contributed positively to student achievement. It is also interesting to note that teacher 5B (teacher 5 at school B) had the highest collective teacher efficacy score and also had the highest physical science and

chemistry scores. This evidence implied that there was also a connection between a teacher's individual teacher efficacy and student achievement, which was not a part of this study, but supported by several researchers (Ashton & Webb, 1986; Moore & Esselman, 1992; Roberts & Henson, 2000; Ross, 1992; Watson, 1991).

Limitations

This study was limited by several factors. First, the study focused on four high schools in a rural, low wealth district in Northwestern North Carolina. These four high schools have an average of 700 students per school. Therefore, generalizations outside this area should not be made. Second, this study focused only on science teacher perceptions of collective efficacy and did not account for other variables throughout the rest of the school. By focusing entirely on science teacher perceptions, the study was also limited by having 24 teacher participants. The low number of participants made some predictive statistical analyses impossible. The study was also limited by using the North Carolina end-of-course test data for physical science, biology, chemistry, and physics. Therefore, generalizations outside these parameters cannot be made. A final limitation to be considered was that the author of this study personally administered the Collective Teacher Efficacy Instrument surveys to the science teachers. Anonymity and confidentiality were communicated and very obvious throughout the entire process. Some participants may have contemplated their responses to help protect their identity. This contemplation was not considered a major validity issue due to the nature of the items on the survey. It was still considered, however, as a possible limiting factor.

Conclusions

The conclusions for this study are presented by addressing each research question individually in separate sections. The reader is cautioned about generalizations as this is a

point-in-time study of four high schools. The reader should also keep in mind that these conclusions are based on data representing science teacher perceptions at the four high schools and other factors are not considered in this study.

Section 1: Research Question One

What is the impact of collective teacher efficacy on student achievement on the tested North Carolina science curriculum?

To address this question, Pearson's Bivariate correlations were calculated to look for relationships between collective teacher efficacy and student test data on the North Carolina end-of-course tests in physical science, biology, chemistry, and physics. Since a small number of participants were used in the study and in order to get statistically sound data, cases were weighted based on the number of students tested for each subject. Based on the findings (Table 13), moderate correlations were found between collective teacher efficacy and physical science ($r = 0.469$, $p < 0.01$), biology ($r = 0.696$, $p<0.01$), and chemistry ($r = 0.560$, $p<0.01$). A strong correlation was found between collective teacher efficacy and physics ($r = 0.816$, $p<0.01$). Therefore, it can be concluded that collective teacher efficacy does have a positive impact on student achievement in science at the high school level.

Section 2: Research Question Two

What is the impact of group competence on student achievement on the tested North Carolina science curriculum?

Pearson's Bivariate correlations were used to examine relationships between the group competence scores of the participants and the tested subjects of the North Carolina science curriculum (physical science, biology, chemistry, and physics). Cases were weighted to reflect the number of students tested in each subject area in order to produce

statistically sound data. Without weighting the cases, the small number of teacher participants provided no sound predictive statistical information. Based on the findings of the Pearson's Bivariate correlations (Table 15), a weak correlation was found to exist between group competence and physical science (r = 0.333, $p<0.01$). Moderate correlations were found between group competence and biology (r = 0.598, $p<0.01$) and group competence and chemistry (r = 0.429, $p<0.01$). A strong correlation was found between group competence and physics (r = 0.801, $p<0.01$). These correlations suggested that group competence is a contributing factor in student achievement as measured by the North Carolina end-of-course tests for science at the high school level.

Section 3: Research Question Three

What is the impact of group task analysis on student achievement on the tested North Carolina science curriculum?

Pearson's Bivariate correlations were once again employed to examine relationships that existed between the construct of group task analysis and each of the tested science subjects from the North Carolina science curriculum (physical science, biology, chemistry, and physics). Again, cases were weighted to reflect the number of students taking each course in order to provide more accurate, predictive statistical results. Based on the results (Table 17), physical science and biology showed a moderate correlation to group task analysis, while chemistry and physics showed a strong correlation to group task analysis. The correlations to group task analysis for each tested science subject were: physical science (r = 0.453, $p<0.01$), biology (r = 0.487, $p<0.01$), chemistry (r = 0.826, $p<0.01$), and physics (r = 0.906, $p<0.01$). These correlations indicated to the researcher that the group task analysis construct of collective teacher efficacy played a positive impact on student achievement as measured by the North

Carolina end-of-course tests for science at the high school level.

Section 4: Research Question Four

Which construct of collective efficacy, group competence or group task analysis, impacts student achievement the most in the tested North Carolina science curriculum?

In order to explore this research question, a stepwise regression analysis was utilized. The cases were weighted according to the number of students tested for each of the tested courses of physical science, biology, chemistry, and physics. For each calculated case, the tested science subject was entered as the dependent variable and the constructs of collective efficacy were listed as the independent variables (Table 18). Through the regression analysis, it was determined that group task analysis was the major contributing factor for student achievement based on the following values: physical science ($\beta = 0.385$, $p<0.000$), chemistry ($\beta = 1.385$, $p<0.0000$), and physics ($\beta = 2.937$, $p<0.000$). It was also determined that the group competence construct was the major contributing factor for biology ($\beta = 0.513$, $p<0.000$). Based on these results, one could conclude that group task analysis is the major contributing factor for the physical sciences, while group competence is the major contributing factor for the life sciences.

Section 5: Research Question Five

What differences, if any, exist among student achievement on the tested North Carolina science curriculum at each of the four high schools in relation to collective efficacy, group competence, and group task analysis?

Due to the low numbers of teacher participants involved at each of the four high schools, only simple, descriptive, statistical methods were applied to address this research question. Other, more complex methods were not deemed as being statistically sound for valid results. Tables 19, 20, 21, and 22 represent the data for each teacher and each

school based on collective teacher efficacy, group competence, group task analysis, and end-of-course test scores. Based on these data, school D had the highest overall collective teacher efficacy, 96.8 out of a possible 126, as well as the highest group competence score, 67 out of a possible 78. School D had the second highest group task analysis score with 29.6 out of a possible 48. School B had the next highest overall collective teacher efficacy score, 94.5 out of possible 126, as well as the next highest group competence score with 63 out of a possible 78. School B had the highest group task analysis score with 31.8 out of a possible 48. School C had the lowest overall collective teacher efficacy score with 83.8 out of a possible 126, as well as the lowest group competence score with 59 out of a possible 78. School C had the next to the lowest group task analysis score with 25 out of a possible 48. School A had the second lowest overall collective teacher efficacy score with 84.2 out of a possible 126, as well as the next to lowest group competence score with 60 out of a possible 78. School A did have the lowest group task analysis score with 24 out of a possible 48. These data can also be seen in Table 23.

Table 23

Individual School Mean Collective Efficacy Scores

	Collective Teacher Efficacy Score - Maximum = 126	Group Competence Score - Maximum = 78	Group Task Analysis Score - Maximum = 48
School A	84.2	60	24
School B	94.5	63	31.8
School C	83.8	59	25
School D	96.8	67	29.6

One can also notice from examining Tables 19, 20, 21, and 22, that school D had the highest student achievement scores in physical science, biology, and physics, while

school B had the highest student achievement scores in chemistry. This scenario should stand to reason since schools B and D had the highest mean collective teacher efficacy, group competence, and group task analysis scores. This condition of high collective teacher efficacy scores, high group competence scores, and high group task analysis scores along with high student achievement is in complete accord with prior research done at the elementary and middle grades (Ashton & Webb, 1986; Goddard et al., 2000; Moore & Esselman, 1992; Roberts & Henson, 2000; Ross, 1992; Watson, 1991). The evidence in this study suggests the same relationships hold true for high school science.

Discussion

Based on the evidences found throughout this study, it was very clear that collective teacher efficacy, along with its two constructs (group competence and group task analysis) had a positive impact on student achievement in high school science. It also became very clear that schools with a higher level of collective teacher efficacy had better student achievement scores in science, as was the case with schools B and D. Furthermore, evidence indicated that both constructs of collective efficacy, group competence and group task analysis, contributed to student achievement in high school science. However, group competence was the major contributing factor for biology, while group task analysis was the major contributing factor for physical science, chemistry, and physics.

When considering the results obtained through the Collective Teacher Efficacy Instrument (Tables 8 and 9), several areas for possible staff development became evident. Based on participant responses to statements 7 and 8 the teachers felt they needed more training on how to reach students who have given up on their own learning or those students who are typically hard to reach. Participants also had very low scores for

statements 11 and 12, which indicated the teachers felt their students were not coming to school ready to learn and the students' home lives did not provide advantages for students to learn. Low scores for statement 13 indicated teachers felt that a lack of instructional material and supplies made teaching more difficult.

Possible staff development areas that could address some of these issues listed above might include targeted differentiation training where emphasis is placed on motivational strategies to engage hard to reach students. Another possible staff development area that would address issues listed above would be to offer training at the high school level that promoted high expectations of learners regardless any limiting factors. The school system is currently working with its middle schools on this type of training to increase awareness of all types of diversity including race, religion, culture, socioeconomics, stereotypes, etc. and set a tone of high expectation for student achievement. This type of training could certainly address issues about students not coming to school prepared or with home lives advantageous to developing needed background knowledge. Still another possible staff development opportunity that arose from the findings of this study is having teachers share ideas on effectively teaching various topics with very limited resources. Because of facility and technology needs, little funds have been available for replenishment of science supplies over the past 5 years in this system. With current budget restraints from the state level, it is also unlikely that sufficient funds will be available for supplies in the near future.

Goddard (2001), Manthey (2006), and Brinson and Steiner (2007) have suggested that building collective efficacy within a school begins with developing an empowered faculty with strong leadership who can unite the group for a common cause. Goddard suggested one way to attain unity is through meaningful performance feedback. Manthey

suggested school leaders should promote mastery experiences for teachers and facilitate that process through a coaching/mentoring process. Brinson and Steiner uphold Goddard and Manthey's ideas; however, they also contend that teachers must have vast opportunities for building instructional knowledge and skills. These building level suggestions can also help promote more collective efficacy where it is needed in schools A and C and help to continue to build upon the collective efficacy levels that already exist in schools B and D.

Recommendations

1. It is recommended that staff development opportunities be made available for science teachers that address the specific needs unveiled by this study. Targeted differentiation training on how to reach hard to reach students and motivate students should happen as soon as possible. This intervention would have a direct influence on the group competence construct, which most directly impacts biology achievement scores. This is very critical since biology is an exit standard course requiring a level III of proficiency for graduation.

2. It is recommended that the system proceed with training for the high school faculties on high student expectations. This training should help with understanding the needs of students and helping them become more prepared as learners. Teacher sharing sessions should also be planned so that teachers may have other creative resources available to compensate for a lack of instructional material. These interventions should help with these needs in the group task analysis construct, which in turn should have the greatest impact on student achievement scores in physical science, chemistry, and physics.

3. It is recommended that school building administrators in this system follow the

guidelines presented by Goddard (2001), Manthey (2006), and Brinson and Steiner (2007) in order to build collective efficacy at the school building level. The school system is already helping with this endeavor, to an extent, by helping fund science teachers' attendance at national science conferences. Investing in teachers to build their teaching repertoire should help with building human capital within the school.

4. The researcher also highly recommends further research into the reasoning for the strong relationship between group task analysis and student achievement in the physical sciences (physical science, chemistry, and physics) and the strong relationship between group competence and student achievement in the life sciences (biology). This further research might also examine the relationships between the teachers' mathematical background and/or the students' mathematical background and the two collective teacher efficacy constructs, since the physical sciences have more mathematical content.

Summary

Findings of this study indicate collective teacher efficacy has a positive impact on student achievement in high school science. Further analysis also indicates the two constructs of collective teacher efficacy, group competence and group task analysis, have a positive impact on student achievement in high school science. The literature suggested this same phenomenon with elementary and middle schools in the areas of reading, math, and social studies. The literature, however, did not indicate this phenomenon had ever been tested at the high school level with any subject.

Findings of this study indicate group competence is the most contributing factor for student achievement in biology, while group task analysis is the most contributing factor for student achievement in physical science, chemistry, and physics. These findings also tend to suggest that biology achievement scores are more influenced by

internal factors that are controlled within the school, while physical science, chemistry, and physics achievement scores are more influenced by external factors beyond the school's direct control.

The findings of this study also indicate high schools that have the highest levels of collective teacher efficacy have the highest levels of student achievement in science. As indicated in this study, schools B and D had the highest overall collective teacher efficacy score, the highest group competence score, and the highest group task analysis score. Schools B and D, consequently, also had the highest student achievement scores in physical science, biology, chemistry, and physics.

Educators want to see higher achievement in all subject areas, including science. This study suggests that a path to that higher achievement is through building collective teacher efficacy. Hopefully leaders can develop strategies that will enhance teachers' knowledge and, consequently, their confidence and their students' achievement.

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Appendix A

Collective Teacher Efficacy Instrument

Collective Teacher Efficacy Instrument

This survey is designed to gather information regarding the collective efficacy beliefs of teachers- a staff's belief in their abilities to affect student outcomes. There are no correct or incorrect answers.

INSTRUCTIONS: Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate numeral to the right of each statement that most accurately reflects your belief or that most closely matches your feeling about the statement.

KEY: 1 = Strongly Disagree 2 = Moderately Disagree 3 = Disagree Slightly More Than Agree
4 = Agree Slightly More Than Disagree 5 = Moderately Agree 6 = Strongly Agree

1	Teachers in this school have what it takes to get the children to learn.	1 2 3 4 5 6
2	Teachers in this school are able to get through to difficult students.	1 2 3 4 5 6
3	If a child doesn't learn something the first time, teachers will try another way.	1 2 3 4 5 6
4	Teachers here are confident they will be able to motivate their students.	1 2 3 4 5 6
5	Teachers in this school really believe every child can learn.	1 2 3 4 5 6
6	If a child doesn't want to learn teachers here give up.	1 2 3 4 5 6
7	Teachers here need more training to know how to deal with these students.	1 2 3 4 5 6
8	Teachers in this school think there are some students that no one can reach.	1 2 3 4 5 6
9	Teachers here don't have the skills needed to produce meaningful student learning.	1 2 3 4 5 6
10	Teachers here fail to reach some students because of poor teaching methods.	1 2 3 4 5 6
11	These students come to school ready to learn.	1 2 3 4 5 6
12	Home life provides so many advantages they are bound to learn.	1 2 3 4 5 6
13	The lack of instructional materials and supplies makes teaching very difficult.	1 2 3 4 5 6
14	Students here just aren't motivated to learn.	1 2 3 4 5 6
15	The quality of school facilities here really facilitates the teaching and learning process.	1 2 3 4 5 6
16	The opportunities in this community help ensure that these students will learn.	1 2 3 4 5 6
17	Teachers here are well prepared to teach the subjects they are assigned to teach.	1 2 3 4 5 6
18	Teachers in this school are skilled in various methods of teaching.	1 2 3 4 5 6
19	Learning is more difficult in this school because students are worried about their safety.	1 2 3 4 5 6
20	Drug and alcohol abuse in the community make learning difficult for students here.	1 2 3 4 5 6
21	Teachers in this school do not have the skills to deal with student disciplinary problems.	1 2 3 4 5 6

Appendix B

Permission to use the Collective Teacher Efficacy Instrument

Mark, Thanks, your abstract would be great. Best, RG

Quoting "burchamm@wilkes.k12.nc.us" <burchamm@wilkes.k12.nc.us>:

> Dr. Goddard,
> Thank you so very much. I hope to finish my dissertation around
> January. I am defending my proposal August 9. I will be happy to send
> the results of my findings when I finish. Again, much thanks. Mark
> Burcham
>
> Original Message:
> -----------------
> From: Roger Goddard rgoddard@umich.edu
> Date: Wed, 16 Jul 2008 18:33:43 -0400
> To: burchamm@wilkes.k12.nc.us
> Subject: Re: Collective Teacher Efficacy Instrument
>
> Dear Mark,
>
> You have my permission to use the instrument. I believe the journal
> requires a citation to the publication you mentioned also. The only
> thing I ask in return us that you provide an abstract of your
findings
> when you finish.
>
> RG
> Sent from my iPhone.
>
> On Jul 16, 2008, at 3:10 PM, "Mark Burcham"
> <burchamm@wilkes.k12.nc.us> wrote:
>
>> Dr. Goddard,
>>
>> I am currently a doctoral student with Gardner-Webb University in
>> North Carolina. For my dissertation, I am working on the impact of
>> collective efficacy on high school science achievement. As a part of
>> my research, I would like to use the Collective Teacher Efficacy
>> Instrument that was published in your article in 2000 along with Hoy
>> and Woolfolk Hoy. This survey instrument looks most closely at what
>> I want to get at in my study, particularly by looking at collective
>> efficacy in terms of group competence (internal locus of control)
and
>> the group task analysis (external locus of control). If I may have
>> permission to use the instrument, I would be extremely grateful.
>> Also, if you have any words of wisdom for my study, I am open for
>> suggestions.
>>
>> Thanks,
>> Mark W. Burcham
>> Math/Science Coordinator
>> Wilkes County Schools
>> 336-667-1121
>> 336-667-0784 (Fax)
>>
> --
> mail2web.com – Enhanced email for the mobile individual based on
> Microsoft® Exchange - http://link.mail2web.com/Personal/EnhancedEmail

>
--
Roger D. Goddard, Ph.D.
Associate Professor of Education
University of Michigan School of Education
Rm. 4111
610 E. University Avenue
Ann Arbor, MI 48109-1259

Appendix C

Collective Teacher Efficacy Instrument Cover Letter

September 25, 2008

Dear Colleagues,

Attached to this cover letter, you will find a survey dealing with collective teacher efficacy. Collective teacher efficacy refers to a staff's belief in their abilities to affect student outcomes. As a part of doctoral studies at Gardner-Webb University, I am writing a dissertation on the impact of collective efficacy on student achievement.

I would like to ask you today for your help with that endeavor by completing the attached survey. Of course, you are in no way obligated to complete the survey, but I do hope that you would consider it. I would ask that you fill out the survey completely and honestly as you feel. I also would ask that you put your name on the survey. I can assure you that these surveys will only be used for data collection purposes for my study and will be destroyed once the data collection process is over. Putting your name on the survey will in no way effect you job, nor will any school administrators ever see what you put on the survey.

I hope that by completing this study with your honest and accurate input on the survey, better and more relevant staff development opportunities can be aligned to your school system.

Please fill out the survey by circling the appropriate numeral to the right of each statement that most accurately reflects your belief or that most closely matches your feeling about the statement regarding the school system as a whole. When you have finished the survey, you may place them in the box located near the door.

Thank You,

Mark W. Burcham
Doctoral Student
Gardner-Webb University

Appendix D

Permission from Superintendent to Perform Study

Home
Community
Schools

Wilkes
County
Schools

Superintendent
Stephen C. Laws, Ed.D.

Deputy Superintendent
Kaye L. Lamb, Ed. S.

Associate Superintendent
Wanda Hutchinson, Ed.D

Assistant Superintendent
Nancy Wilson

July 21, 2008

I hereby grant permission to Mark W. Burcham to access the science teachers of four high schools in September of 2008 for the purpose of his study on the impact of collective teacher efficacy on student achievement. I understand Mr. Burcham's study will be supervised by Dr. Vicky Ratchford of Gardner-Webb University and that a review board will approve the study before the data are collected. I confirm that Mr. Burcham has received verbal permission from the principals of the four schools. Please contact me if I may be of further assistance.

Sincerely,

Dr. Stephen C. Laws

Superintendent, Wilkes County Schools

Appendix E

The Collective Teacher Efficacy Instrument Participant Results for Each Statement

The Collective Teacher Efficacy Instrument Participant Results for Each Statement

Participant #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1A	6	5	5	5	5	6	6	6	6	6	2	1	1	3	3	3	6	6	6	6	6
2A	5	5	6	4	4	6	3	3	6	6	1	1	1	4	4	3	6	6	5	3	6
3A	5	4	5	4	4	2	2	1	4	4	2	2	2	2	4	2	5	5	6	3	4
4A	5	4	4	5	4	5	1	2	4	2	1	1	2	3	5	3	5	5	6	3	4
5A	4	3	5	5	5	6	4	5	5	5	3	2	1	4	4	2	5	5	5	5	5
1B	6	5	6	5	5	5	3	5	5	5	4	4	5	5	5	5	6	5	5	6	5
2B	3	3	4	3	4	4	2	4	4	2	2	3	3	3	5	3	4	4	4	4	4
3B	6	5	4	5	5	5	5	3	5	5	4	2	5	5	5	5	5	5	5	5	5
4B	5	5	5	5	5	6	5	6	6	4	4	1	4	6	5	4	6	5	6	5	6
5B	6	5	6	6	6	6	6	6	6	5	3	2	5	6	3	2	6	6	6	6	6
6B	5	5	5	4	4	4	5	3	5	4	3	3	1	4	4	3	5	4	5	2	4
7B	6	5	5	4	4	5	2	3	6	4	3	3	2	5	5	2	4	4	5	3	6
8B	6	5	5	6	6	5	5	4	6	4	1	3	3	5	4	5	6	6	6	4	4
1C	4	3	4	3	3	4	1	1	5	2	3	1	3	2	4	2	4	3	5	4	3
2C	6	5	5	5	5	6	3	4	6	5	3	1	2	3	6	3	6	5	6	6	5
3C	6	4	5	5	5	6	4	5	6	5	1	1	2	1	3	1	6	6	6	2	6
4C	6	5	5	5	4	5	5	4	5	4	2	1	4	4	4	3	5	4	5	2	4
5C	6	5	6	5	6	6	3	3	6	6	3	1	2	3	6	2	6	6	6	3	6
6C	5	3	4	4	2	3	3	3	5	3	3	2	2	3	6	5	4	4	4	3	4
1D	6	6	6	6	6	4	3	3	5	5	3	3	3	3	5	4	6	6	6	3	4
2D	6	6	5	5	6	5	6	6	5	5	2	3	3	4	5	3	6	5	5	3	4
3D	6	5	6	6	6	2	2	2	6	4	2	4	1	3	6	3	6	5	5	4	5
4D	6	6	6	5	5	6	5	3	6	6	3	3	1	3	6	3	6	6	6	4	5
5D	6	5	6	5	5	6	4	4	6	5	4	4	4	4	5	3	5	5	6	4	5

Numbers 1-21 indicate survey statement on the Collective Teacher Efficacy Instrument