TEACHER PARTICIPATION IN PROFESSIONAL ACTIVITIES AND JOB SATISFACTION: PREVALENCE AND ASSOCIATIVE RELATIONSHIP TO RETENTION FOR HIGH SCHOOL SCIENCE TEACHERS

A Dissertation

by

TODD DANE BOZEMAN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2010

Major Subject: Curriculum and Instruction

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ABSTRACT

Teacher Participation in Professional Activities and Job Satisfaction: Prevalence and Associative Relationship to Retention for High School Science Teachers.

(December 2010)

Todd Dane Bozeman, B.S., Lubbock Christian University;

M.Ed., Texas A&M University

Chair of Advisory Committee: Dr. Carol L. Stuessy

In this dissertation, I used survey response data from 385 science teachers situated in 50 randomly selected Texas high schools to describe the prevalence of high school science teacher participation in professional activities and levels of job satisfaction. Using relative risk statistics, I determined the direction and significance of multiple associative relationships involving teachers' participation in professional activities, satisfaction with working conditions, and retention state. Finally, I used these results to make specific policy recommendations.

Teachers participate in diverse professional activities. Descriptive analyses of responses from teachers revealed higher rates of participation in development activities than in maintenance or management activities. Relative risk statistics exposed several positive and significant associative relationships between participation in specific professional activities (i.e., observation of other science teachers, involvement in a science education study group) and teacher retention. Additionally, results of risk

analyses suggest teacher participation in maintenance activities, more than development or management, is associated with teacher retention.

Researchers consider job satisfaction an important factor in teacher retention. Descriptive analyses revealed high rates of satisfaction with occupational choice and the interpersonal relationships shared with professional colleagues and administrators. Conversely, teachers expressed low rates of satisfaction with their school's science laboratory facilities and equipment or support for student involvement in informal science activities. Results of risk analyses exposed no positive associations between job satisfaction and retention for teachers.

The interaction between teacher participation in professional activities and satisfaction with occupational choice was also examined. Descriptive analyses of responses from retained teachers (n=291) revealed high rates of participation in development activities in comparison to maintenance or management activities. Results of risk analyses exposed both positive and negative associations between teacher participation in professional activities and satisfaction with occupational choice, suggesting an interactive effect exists between participation in activities and satisfaction with occupational choice on retention.

I used results from analyses to make state and school level policy recommendations, which included: (a) development of state standards for classroom equipment and facilities; (b) greater state involvement in defining teacher professional activities; and, (c) increasing school support for teacher participation in maintenance activities.

DEDICATION

"Genius without education is like silver in the mine."

Benjamin Franklin

The completion of a dissertation, regardless the topic, is an arduous journey completed by more than a solitary author. The author requires the companionship of like-minded individuals, the aggravation of small-minded naysayers, and the understanding of disinterested loved ones. Therefore, I dedicate this dissertation to both my colleagues and detractors; however, more than them, I dedicate this dissertation to those who "know who you are."

ACKNOWLEDGEMENTS

First, I would like to thank my committee chair and mentor, Dr. Stuessy. Second, I wish to express my thanks to each committee member, Dr. Kelly, Dr. Schielack, and Dr. Scott, for their expertise, patience, and assistance throughout the course of this research.

Thanks also go to my friends, colleagues, and members of my department for making my time at Texas A&M University a great experience. I want to thank the PRISE fellows who worked with me during the last five years. I also want to extend my gratitude to the National Science Foundation, which provided the support for my research, and to all the Texas high school teachers and their principals who were willing to participate in the study.

Finally, I must thank my parents, brothers, sister, nephews, and niece for their encouragement and support.

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CHAPTER I

INTRODUCTION

A crisis in the United States public education system is looming. Projections of student enrollment in elementary and secondary schools by the U.S. Department of Education (Hussar, 2005) indicate an increase in the student population of four percent by the end of the ten year period ending in 2014. Concurrently, beginning in the 1990's many states implemented policies setting student-teacher ratios in classrooms to limit the number of students per teacher (Feng, 2005). These two factors, combined with the "graying" of the teacher population (Ingersoll, 2001), have spurred national and state level interest regarding teacher retention. While researchers anticipate teacher shortages within public school classrooms in general (Luekens, Lyter, & Fox, 2004), teacher shortages in high school science classrooms are of particular concern to stakeholders and policy makers who recognize the importance of teachers in assuring a scientifically literate 21st century society (Bozeman & Stuessy, 2009; Ingersoll, 2001).

A school experiences the loss of a teacher in multiple ways. Each loss incurs a cost to the school in both tangible and intangible factors. The website of the National Commission on Teaching and America's Future (NCTAF) provides a calculator to estimate the financial costs of replacing a teacher -- between $3,600 (non-urban schools)

This dissertation follows the style of *Educational Evaluation and Policy Assessment*.

and $8,400 (urban schools). A school that loses a teacher, however, loses much more than money. A school that loses a teacher in the first years of his career loses investments of time and effort by administrators and other teachers in recruiting, orienting and mentoring the new teacher into the profession (Smith & Ingersoll, 2004). Loss of an experienced teacher can be even more costly, however, when one considers the contributions of a veteran teacher to the overall school culture (Kardos, Johnson, Peske, Kauffman, & Liu, 2001), mentoring of teachers (Brennan, 2003), and achievement of students (Hare & Heap, 2001; Hawley, 2000; Carroll & Foster, 2010).

NCTAF warns that the "teaching career pipeline is collapsing at both ends," with "even our highest performing schools and districts … about to lose much of the expertise that has been at the core of their success for decades" (Carroll & Foster, 2010, p. 4). A one-year study by NCTAF concluded that "with the loss of veterans and the high turnover of beginners, the base of teaching experience in our schools is becoming thinner and thinner" (Carroll & Foster, 2010, p. 5). The three studies proposed for this dissertation address teacher mobility through investigations of two correlations to teacher retention, teacher participation in professional activities and satisfaction with working conditions. Each correlate is considered an important factor associated with teacher retention. For example, Day (2008) makes the case that participation in professional activities is a necessary step in the development of a teacher, as well as in the management and maintenance of the profession. Additionally, Skaalvik & Skaalvik (2009) contend that satisfaction with working conditions is an important factor associated with teacher mobility.

Associative Model of Teacher Mobility

Wright (2006) argues that most scientific researchers support the use of causal hypotheses in research. Specifically, usages of hypotheses that allow researchers to infer changes in one variable are a direct result of changes in another variable. However, Wright also believes that researchers should not limit the scope of hypothetical relationships in scientific research. My review of literature led me to develop a model of teacher mobility (see Figure 1) that assumes associative (rather than causal) relationships between a number of variables related to schools and teachers. I categorized these variables as decision, need, and characteristic.

Variables of Interest

Teacher mobility is the inclusive term for outcomes associated with teacher employment, including retention, attrition, and migration (i.e., transfer between schools). Reasons for teachers' leaving or staying at a school or in the profession are numerous (e.g., see Butt, Lance, Fielding, Gunter, Rayner, & Thomas, 2005; Day, Elliot, & Kington, 2005; Elfers, Plecki, & McGowan, 2007). Examples include salary, working relationships, working conditions, advancement opportunities, student population characteristics, professional responsibilities, and school leadership. Individually, each of these reasons is not likely to cause a teacher to leave or stay at a school or in the profession. However, an associative model makes it possible for a researcher to determine which reasons are more likely to be linked with teacher mobility.

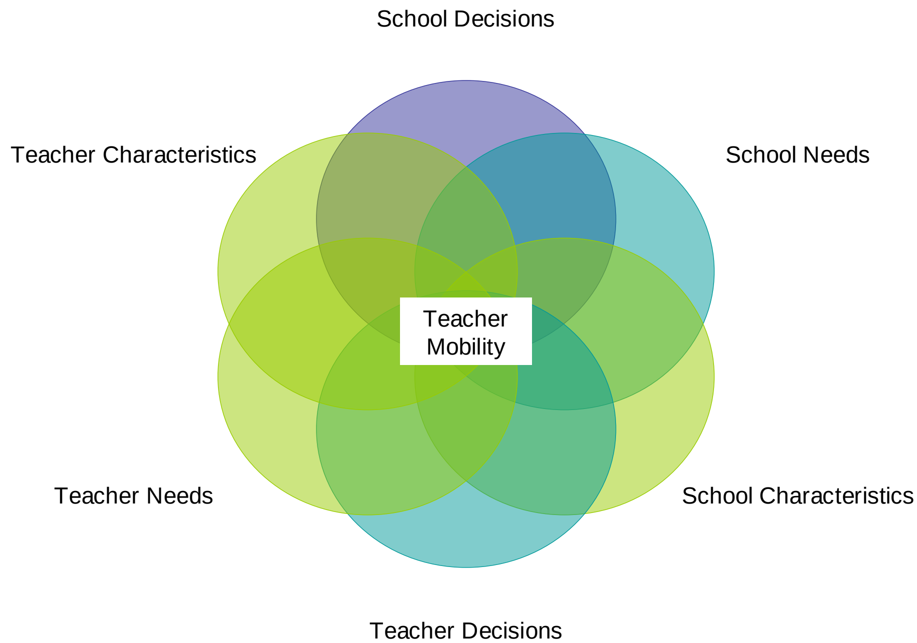

FIGURE 1. *An associative model describing teacher mobility. School- and teacher-related categories interacting in the model are associatively linked (rather than causally linked) with states of teacher mobility.*

Teacher participation in professional activities and job satisfaction have direct implications for the roles that responsible schools play in a teacher retention (see., e.g. Borman & Dowling, 2008; Eick, 2002; Liu & Ramsey, 2008; Weiqi, 2007). For example, rewards for a teacher's participation in professional activities, such as mentoring, providing leadership in the science program, or attending extended professional development, may influence teacher retention. Another example is related to the complex construct, job satisfaction. Schools that pay attention to those variables influencing a teacher's satisfaction (e.g., administrative support, science teaching environment, personal satisfaction, and collegiality) may influence the retention of their teachers (Brennan, 2003).

Teacher Participation in Professional Activities

Many professions encourage their members to become involved in activities that define the profession. These activities can include personal development (Garet, Porter, Desimone, Birman, & Yoon, 2001; Moskvina, 2006), recruitment and mentorship of new members (Koballa, Bradbury, Glynn, & Deaton, 2008; Penlington, 2007), and leadership (McDonald, 2008). Although similar across professions, professional activities are customized according to the specifications and customary activities associated with the profession (Okoye, Momoh, Aigbomian, & Okecha, 2008; Penuel, Fishman, Yamaguchi, & Gallagher, 2007) and the needs of its members (Day, 2008; Huang & Fraser, 2009).

Teacher Job Satisfaction

The majority of large-sample research (i.e., research using more than 30 subjects) in the area of high school teacher satisfaction does not divide teachers into specific content areas. As a result, few large-sample studies of job satisfaction exist that are specific to high school science teachers. Hean and Garrett (2001), however, studied 47 Chilean secondary science teachers. They found that the majority of teachers surveyed derived job satisfaction from relationships with administrators, colleagues, and students; opportunities to influence future generations; and opportunities to influence individual students. Conversely, analysis of teacher responses indicated the greatest sources of job dissatisfaction were salary, excessive workload, resources, infrastructure, and student characteristics.

Teacher Mobility

Education policy attempts to produce positive student, teacher, and school outcomes (i.e. to, increase student achievement, improve teacher standards, and strengthen the learning environment within the school). Education stakeholders view the design and adoption of policies as a means for addressing teacher mobility (Day, Elliot, & Kington, 2005). The need for recruiting individuals to teach in United States classrooms is currently increasing. The National Center for Educational Statistics (NCES) has reported that the public school student population will increase by approximately four percent during a ten-year period ending in 2014 (Hussar, 2005). Additionally, at least half of all states now have some form of policy or program in place that decreases teacher-student ratios (e.g., decreased ratios from one teacher per 30 students to one teacher per 24 students; see Feng, 2005). Finally, with passage of the *No Child Left Behind Act of 2001* (NCLB) many states are beginning to address current and future teacher's certification and content knowledge standards (Cohen-Vogel & Smith, 2007; Elfers, Plecki, & McGowan, 2007; Hirsch, Koppich, & Knapp, 2001). The combination of these factors has led many education researchers to study the general issue of teacher mobility (Feng, 2005; Luekens, Lyter, & Fox, 2004; Macdonald, 1999) and high school science teacher mobility specifically (Eick, 2002; Ingersoll, 2006).

Rationale for Proposed Papers

The need for science teachers occurs at a time in educational history when opportunities for advancement, benefits, and working conditions appear more attractive in other science-related occupations (Borman & Dowling, 2008). Furthermore, standards have increased for teacher certification at a time when most U.S. state governments have implemented high-stakes testing for student populations (Feng, 2005). As a result, stakeholders in high school science education ask themselves, "How can we meet the demands of higher standards for student learning while reducing teacher mobility"?

One method for answering the question is by investigating associative relationships between teacher mobility and teachers' participation in professional activities or job satisfaction (see Figure 2). It is probable that these relationships are linked to the larger system described in Figure 1. Identification of relationships of greatest significance provides stakeholders with information relevant to the practices and beliefs of current high school science teachers. Therefore, a study of the associative relationships between teacher participation in professional activities, their current job satisfaction, and mobility may provide some answers to questions regarding the retention of high school science teachers and thus offering suggestions for ways to improve the high school science education system.

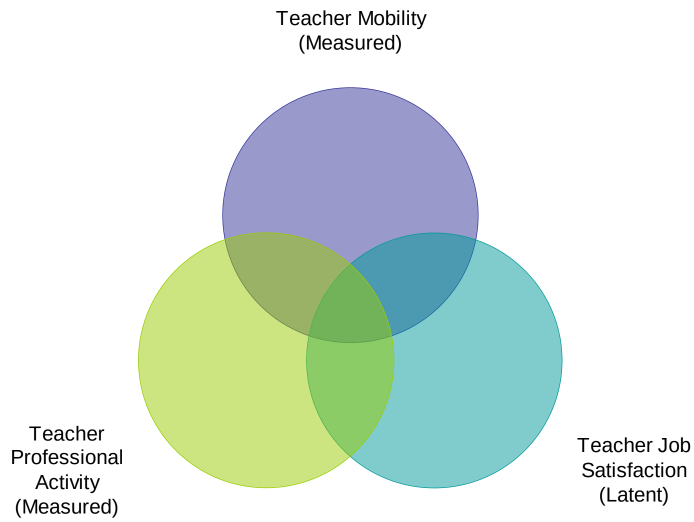

FIGURE 2. *An associative relationship between teacher mobility, professional activity, and job satisfaction.*

Relative Risk Assessment

The relative risk (RR) statistic identifies associative relationships between variables of interest. Relative risk assessment is a data analysis strategy using binary response data describing individual behavior or attitudes for members of two distinct populations. This strategy is common in medical research (Maddox, Reid, Spertus, Mittleman, Krumholz, Parashar, Ho, & Rumsfield, 2008); however, I have yet to discover any published articles in the science education literature using a risk assessment strategy to identify relationships of association between teacher behavior, attitude, and/or mobility.

The RR statistic describes the probability that a member of an exposed group will commit an action relative to the probability that a member of an unexposed group will commit the same action. If the RR equals 1.0 or is encompassed within the 95% confidence interval (95% CI) the researcher assumes no association between the exposure and action. However, if the RR is greater than or less than 1.0 and is not encompassed within the 95% CI, the researcher can assume a relationship of association exists between the exposure and action. For example, if we know from a sample, the number of teachers exposed to a specific professional activity and the number of teachers retained at their school, then we can calculate probabilities to determine the associative relationship between the professional activity and teacher retention for teachers in the sample. If the sample has high population validity, researchers have quantitative evidence to support policy recommendations for the population of teachers from which the sample was drawn.

CHAPTER II

PROFESSIONAL ACTIVITY, JOB SATISFACTION AND MOBILITY OF HIGH SCHOOL SCIENCE TEACHERS: A REVIEW OF LITERATURE

As previously mentioned, a potential crisis in the United States (U. S.) public education system is looming. This crisis involves the retention of “highly qualified” science teachers and the net effect of their loss on student achievement (Duschl, 2008; Stuessy, Bozeman, & Ivey, 2010). Some of the primary factors involved in this crisis include projected increases in student enrollment (Hussar, 2005), reduced class sizes (Feng, 2005), and the retirement of “baby boomer” teachers (Ingersoll, 2001). Each of these factors indicates a potential need for the science education profession in general, and schools in particular, to investigate those characteristics, decisions, and needs of schools and teachers related to the retention of teachers (Duschl, 2008). Two correlates of teacher retention, teacher professionalism and job satisfaction, appear to be important factors concerning teachers’ decisions about staying at or migrating from a specific school and leaving or staying in the profession (e.g., teacher mobility). This chapter has two purposes. The first is to synthesize research related to the relationships between and among teachers’ mobility with their job satisfaction and involvement in professional activities; the second is to review the typical research methods used to investigate causal and associative hypotheses related to teacher mobility, job satisfaction, and professional activity. Before addressing these purposes, I provide the reader a short historical perspective on the American education system, a discussion on causal and associative relationships, and an associative model useful for studying relationships of teacher and school variables linked to measures of teacher mobility.

Historical Perspective on the American Education System

Today, America's education system is almost 400 years old with the first public high school opening in 1821 (Folger & Nam, 1967). However, Folger and Nam (1967) note compulsory elementary and secondary school attendance for children in all states did not occur until just before the Second World War. Consequently, for the first three hundred years, the majority of students in America's public education system rarely received structured science education. For example, at the beginning of the 20th century less than 10 percent of the American public graduated from what is commonly considered a secondary or high school (e.g., a school with students in grades 9 through 12) (Thattai, 2001). This would imply that even today many Americans are likely to know or have known close relatives (i.e., grandfathers, grandmothers, fathers, mothers, and siblings) with little or no formal science education beyond the eighth grade. Consequently, for many years the system had little need for large numbers of high school science teachers.

By the latter half of the 20th century, several events began re-shaping the American education system. The system became an apparatus for integrating diverse races (e.g., Brown v Board of Education, Topeka), supporting civil rights (e.g., Elementary and Secondary School Act of 1965) and ensuring national defense (e.g., The Cold War, The Space Race). These events, coinciding with almost 90 percent of the American public receiving a high school diploma, or its equivalence, by the end of the century (Thattai, 2001), made the system a standard for educating both large and diverse populations as the world faced the 21st century (Smith, 2004). Consequently, the system now requires a large and sustained professional teacher population in general and high school science teacher population specifically (Darling-Hammond, 1999).

The 20th century increases in high school attendance and graduation rates create issues for stakeholders (i.e., policy makers) in high school science education. Larger numbers of students participating in high school science have coincided with the implementation of high stakes student testing (Feng, 2005), development of a teacher professional attitude (Darling-Hammond, 1999), and examination of school cultures (Kardos, Johnson, Peske, Kauffman, & Liu, 2001; Stuessy, Bozeman, & Ivey, 2010). Therefore, stakeholders must ask themselves, “How can the current high school science education system be improved upon while retaining high student achievement”?

Causal and Associative Relationships in Education Research

Teacher mobility is the inclusive term for outcomes of teacher employment, including retention, attrition, and migration (i.e., transfer between schools). Many research articles investigating mobility of public school teachers also address issues of teacher professional activity and job satisfaction (see Table 1). A primary interest in this dissertation is research perspectives regarding either causal or associative hypotheses concerning relations between and among the variables of job satisfaction, professional activity, and teacher mobility.

A causal hypothesis examines the relationship between some current event(s) and a future outcome; an associative hypothesis examines how often events occur simultaneously without assuming causality between the events (Wright, 2006).

TABLE 1
Focus and Analysis Method for 43 Reviewed Articles

Article		Article Focus[1]			Analysis Method
Title	Author(s) (Year)	PA	JS	M	
Science teachers' perceptions of the school environment: Gender differences	Huang and Fraser (2009)	●[2]	○		HLM and SEM
Committed for life? Variations in teachers' work, lives and effectiveness	Day (2008)	●		○	Frequency counts and percentages
Teachers' quality, instructional strategies and students' performance in secondary school science	Okoye, Momoh, Aigbomian, and Okecha (2008)	●			Means with SD, T-test, and ANOVA
Conceptions of science teacher mentoring and mentoring practice in an alternative certification program	Koballa, Bradbury, Glynn, and Deaton (2008)	●	○		Qualitative

[1] The focus of each article is classified as professional activity (PA), job satisfaction (JS), or mobility (M).

[2] ● = Major focus of article. ○ = Minor focus of article.

TABLE 1 continued

Article		Article Focus[1]			Analysis Method
Title	Author(s) (Year)	PA	JS	M	
Mentoring new teachers	Hanuscin and Lee (2008)	●[2]	○	○	None
Does policy influence mathematics and science teachers' participation in professional development?	Desimone, Smith, and Phillips (2007)	●	○		HLM
What makes professional development effective? Strategies that foster curriculum implementation	Penuel, Fishman, Yamaguchi, and Gallagher (2007)	●	○		HLM
Dialogue as a catalyst for teacher change: A conceptual analysis	Penlington (2007)	●	○	○	Qualitative
The schoolteacher's risk of personality and professional deformation	Moskvina (2006)	●	○		Qualitative
Key points in the core curriculum of teacher training	Duncker, Kraus-Vilmar, Messner, and Schlomerkemper (2004)	●			None
What makes professional development effective? Results from a national sample of teachers	Garet, Porter, Desimone, Birman, and Yoon (2001)	●	○		Regression

[1] The focus of each article is classified as professional activity (PA), job satisfaction (JS), or mobility (M).

[2] ● = Major focus of article. ○ = Minor focus of article.

TABLE 1 continued

Article		Article Focus[1]			Analysis Method
Title	Author(s) (Year)	PA	JS	M	
Seeing the science: Professional pedagogical vision for instructional leaders	McDonald (2008)	●[2]			None
How times change: Secondary teachers' job satisfaction and dissatisfaction in 1962 and 2007	Klassen and Anderson (2009)	○	●	○	Means with SD, Correlation
Does school context matter? Relations with teacher burnout and job satisfaction	Skaalvik and Skaalvik (2009)		●	○	SEM
The relationship between the perception of distributed leadership in secondary schools and teachers' job satisfaction and organizational commitment	Hulpia, Devos, and Rosseel (2009)		●	○	Means with SD, Regression
Self-efficacy, school resources, job stressors and burnout among Spanish primary and secondary school teachers: a structural equation approach	Betoret (2009)	○	●	○	SEM

[1] The focus of each article is classified as professional activity (PA), job satisfaction (JS), or mobility (M).

[2] ● = Major focus of article. ○ = Minor focus of article.

TABLE 1 continued

Article		Article Focus[1]			Analysis Method
Title	Author(s) (Year)	PA	JS	M	
Factors affecting satisfaction and retention of African American and European American teachers in an urban school district	Kearney (2008)		●[2]	○	Frequency counts and percentages, χ^2 Test
Why should I be a teacher?	Block (2008)		●		None
Teachers' job satisfaction: Analyses of the teacher follow-up survey in the united states for 2000-2001	Liu and Ramsey (2008)	○	●	○	HLM
Literature review of teacher job satisfaction	Hongying (2007)		●	○	None
A study of teacher job satisfaction and factors that influence it	Bolin (2007)	○	●		Correlation
The structure of secondary school teacher job satisfaction and its relationship with attrition and work enthusiasm	Weiqi (2007)	○	●	○	Factor analysis, T-test

[1] The focus of each article is classified as professional activity (PA), job satisfaction (JS), or mobility (M).

[2] ● = Major focus of article. ○ = Minor focus of article.

TABLE 1 continued

Article		Article Focus[1]			Analysis Method
Title	Author(s) (Year)	PA	JS	M	
Teacher job satisfaction: Lessons from the TSW pathfinder project	Butt, Lance, Fielding, Gunter, Rayner, and Thomas (2005)		●[2]	○	Means with SD
Two profiles of schoolteachers: A discriminant analysis of job satisfaction	Bogler (2002)		●		Discriminant analysis
Sources of job satisfaction in science secondary school teachers in Chile	Hean and Garrett (2001)		●		$\chi 2$ Test
Teacher motivation and job satisfaction: A study employing the experience sampling method	Bishay (1996)	○	●		T-Test, ANOVA
The situational occurrences theory of job satisfaction	Quarstein, McAfee, and Glassman (1992)		●		Regression
A validation of Hoppock's job satisfaction measure	McNichols, Stahl, and Manley (1978)		●		Means with SD, Correlations

[1] The focus of each article is classified as professional activity (PA), job satisfaction (JS), or mobility (M).

[2] ● = Major focus of article. ○ = Minor focus of article.

TABLE 1 continued

Article		Article Focus[1]			Analysis Method
Title	Author(s) (Year)	PA	JS	M	
Motivation through the design of work: Test of a theory	Hackman and Oldham (1976)		●[2]		Regression
What is job satisfaction?	Locke (1969)		●		None
Teacher attrition and retention: A meta-analytic and narrative review of the research	Borman and Dowling (2008)	○	○	●	Odds ratios
High school teachers in the workforce: Examining teacher retention, mobility, school characteristics, and school reform efforts	Elfers, Plecki, and McGowan (2007)		○	●	Frequency counts and percentages
Understanding supply and demand among mathematics and science teachers	Ingersoll (2006)			●	Frequency counts and percentages
What are the problems with the teacher supply?	White, Gorard, and See (2006)			●	Frequency counts and percentages

[1] The focus of each article is classified as professional activity (PA), job satisfaction (JS), or mobility (M).

[2] ● = Major focus of article. ○ = Minor focus of article.

TABLE 1 continued

Article		Article Focus[1]			Analysis Method
Title	Author(s) (Year)	PA	JS	M	
New teachers' experiences of hiring: Late, rushed, and information-poor	Liu and Johnson (2006)		○	●[2]	χ^2 Test, T-Test, and ANOVA
Hire today, gone tomorrow: The determinants of attrition among public school teachers	Feng (2005)		○	●	Regression
Teacher attrition and mobility	Luekens, Lyter, and Fox (2004)			●	Frequency counts and percentages
Studying career science teachers' personal histories	Eick (2002)	○	○	●	Qualitative
Teacher attrition: A review of literature	Macdonald (1999)			●	None
The turnover of teachers: A competing risks explanation	Dolton and van der Klaauw (1999)			●	Odds ratios
Teacher recruitment and retention in public and private schools	Ballou and Podgursky (1998)			●	Regression
The influence of classroom characteristics on high school science teacher turnover	Mont and Rees (1996)		○	●	χ2 Test, T-Test, and ANOVA

[1] The focus of each article is classified as professional activity (PA), job satisfaction (JS), or mobility (M).

[2] ● = Major focus of article. ○ = Minor focus of article.

Wright further states that a research method using random group allocation is appropriate when hypothesizing causality. Weiss' (1999) secondary analysis of first-year teacher responses to the U.S. Department of Education's School and Staffing Survey in 1987 and 1993 used random assignment of teachers before conducting factor analysis and regression modeling. Conversely, random sampling is more appropriate for associative hypothesizing (Wright, 2006). Dolton and van der Klaauw's (1999) competing risk explanation of teacher attrition makes use of a 1 in 6 random sample of individuals who graduated from British universities in 1980. The majority of articles (n = 43) listed in Table 1, use causal hypotheses when studying relationships between and among teacher professional activity, job satisfaction, and mobility (see Table 2).

Causal Relationships

A causal relationship can be expressed as X → Y. This relationship assumes that some predictor (X) causes some outcome (Y). In addition, a causal relationship can be expressed as X↔Y (Wright, 2006). This relationship assumes that over time, X and Y cause changes on each other. Weiss (1999) uses the heading, "Factors *associated* (italics added for effect) with first-year teacher morale, career choice commitment, and planned retention"; however, her data analysis methods (e.g., factor analysis and regression) are associated with causal hypotheses. Weiss asserts that the perception of school leadership and culture, as well as teacher autonomy and discretion, *cause* significant changes in first year teachers' attitudes about remaining within the education profession.

TABLE 2
Frequency of Hypothesis Type from 43 Reviewed Articles

Hypothesis Type	Frequency (n)	Example
Causal	18	Huang and Fraser, 2009
Associative	12	Day, 2008
None or not expressed	13	Hongying, 2007
Total	43	

Associative Relationships

An associative relationship can be expressed as X ↑↓ Y. This relationship assumes that some factor (X) occurs simultaneously with another factor (Y). Dolton and van der Klaauw (1999) use log ratios in developing an econometric model describing an associative relationship between teacher pay and attrition. The authors claim that a teacher is more likely to leave the profession if a higher paying job opportunity exists. However, the authors do not claim that increasing teacher salaries will cause fewer teachers to leave the profession. Instead, Dolton and van der Klaauw state that a wage profile should be designed in such a manner as to induce both new and experienced teachers to remain in the profession.

An Associative Model Describing Teacher Mobility

Wright (2006) argues that most scientific researchers support the use of causal hypotheses in research. However, Wright also believes that researchers should not limit the scope of hypothetical relationships in scientific research. Figure 3 presents a model of teacher mobility assuming associative relationships between teacher and school factors (e.g., decisions, needs, and characteristics). The example on the following page is provided to assist the reader in understanding the difference between a causal and associative hypothesis related to teacher mobility.

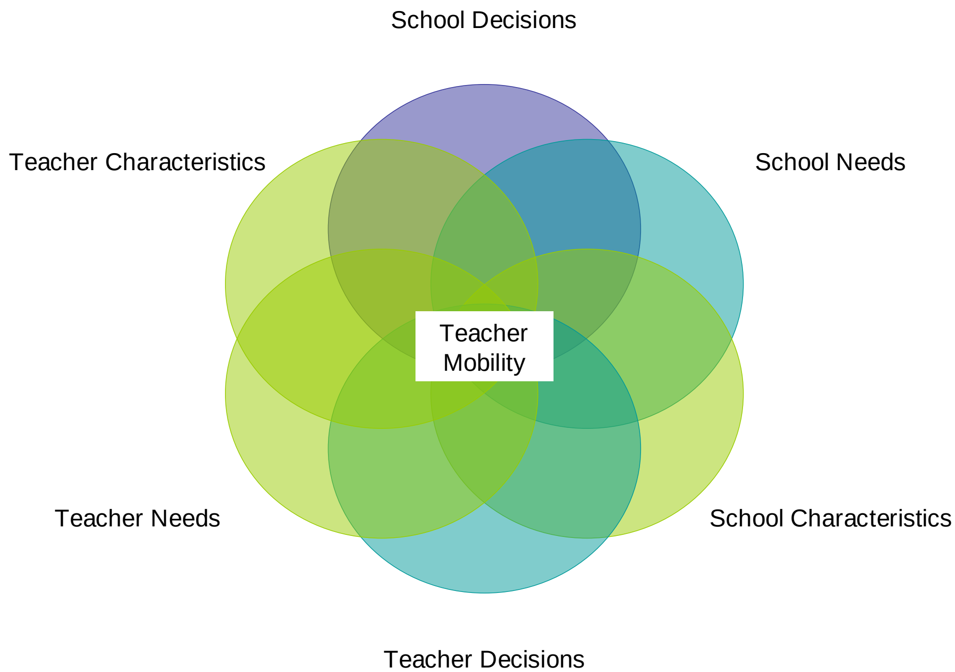

FIGURE 3. *An associative model describing relationships between teacher and school variables with teacher mobility.*

Schools suffering a sudden loss of student enrollment may dismiss teachers. In this example, a causal relationship between student enrollment declines (X) and teacher mobility (Y) can be hypothesized. A researcher can (1) gather data regarding student enrollment and teacher mobility from a series of selected schools, (2) generate a hypothesis stating a causal relationship between declining student enrollment and teacher mobility, and (3) conduct analysis of collected data to determine the existence of a causal relationship. However, this example can also be viewed associatively using probability. A researcher might ask the question, “What is the association between declining student enrollment and teacher mobility?” In this case, a researcher can (1) develop a model to express an associative relationship between teacher mobility and changing school characteristics (e.g., declining student enrollment), (2) randomly select schools from a defined population, and (3) calculate the probabilities of teacher mobility associated with schools that exhibit increasing, decreasing, and stable student enrollments. This does not suppose decline in student enrollment *causes* an increase in teacher mobility but that change in a school’s student enrollment is *associated* with teacher mobility. Subsequently, the researcher can describe teacher mobility using probability functions for estimating associations between a school characteristic (e.g., school enrollment) and teacher mobility (Borman & Dowling, 2008; Dolton & van der Klaauw, 1999; Feng, 2005).

Teacher Professional Activity, Job Satisfaction, and Mobility

Researchers use both teacher and school level variables when conducting research related to teacher mobility. These variables often reflect the complex relationships found within school walls. For example, Borman and Dowling (2008) claim an associative relationship between teacher participation in school mentorship programs (i.e., teacher need) and attrition (i.e., teacher mobility). Specifically, the probability of a teacher leaving the profession is lower for teachers who actively participate in mentorship programs. This association between teacher mobility and professional activity (e.g., mentorship) seems to incorporate a single teacher factor (e.g., teacher needs). However, mentorship programs include not only teacher factors (e.g., characteristics, needs, and decisions), but school factors (e.g., characteristics, needs, and decisions) as well. Regarding Borman and Dowling's claim, mentorship programs in schools reflect not only teacher needs and characteristics but school decisions and characteristics as well. For example, a school having low numbers of teachers (a school characteristic) may not perceive the need to have a structured mentorship program in place (a school decision). Therefore, it may be necessary to study the relationship between mentorship and teacher mobility differently in small schools.

Teacher Professional Activity. A teacher professional activity is an action on the part of an individual teacher that may or may not be initiated by the teacher. An activity initiated by a teacher can be viewed as a teacher need whereas a school initiated activity can be viewed as a school decision. Penlington's (2007) description of teacher-teacher dialogue is an example of a teacher-initiated professional activity. Specifically, teacher-teacher dialogue is an activity in which teachers voice needs with other teachers related to their development as professionals. This type of professional activity is often associated with mentoring, an activity designed to support individuals new to the profession. The individual teacher in this example initiates the professional activity by searching for another teacher to serve in a mentoring capacity. However, a teacher professional activity can also be supported by the school. For example, in the case of a school hiring a new teacher, the school should provide the new teacher with an opportunity to participate in a structured induction program (Hanuscin & Lee, 2008). This type of professional activity, also associated with mentoring, provides new and experienced teachers the opportunity to develop themselves further as professionals within the school, a specific working environment.

Teacher Job Satisfaction. In addition to teacher professional activities, researchers have studied the role of job satisfaction in teacher career development (Bogler, 2002). Teacher job satisfaction is a teacher affect theorized to be influenced by both internal belief structures (i.e., teacher characteristics) and external conditions (i.e., school characteristics) (Butt, Lance, Fielding, Gunter, Rayner, & Thomas, 2005). Currently much of the research regarding job satisfaction of teachers focuses on characteristics of the teacher's work environment, placing emphasis on school characteristics (Borman & Dowling, 2008; Hean & Garrett, 2001; Mont & Rees, 1996).

Teacher Mobility. Analysis in high school science teacher mobility studies support either a causal or an associative link with individual teacher and school-level factors regarding a teacher's decision to stay (retention), move from the current school to another school (migration) or leave the education profession altogether (attrition) (See e.g., Borman & Dowling, 2008; Elfers, Plecki, & McGowan, 2007; Ingersoll, 2001; Luekens, Lyter, & Fox, 2004; Macdonald, 1999.). The conceptual model provided in Figure 3 describes teacher mobility (e.g., retention, migration, and attrition) in terms of individual teacher and school decisions, needs and characteristics. Working from this model, definitions for and measurements of teacher and school factors should then influence all subsequent data analysis methods. Additionally, the model in Figure 3 proposes an associative relationship between teacher and school factors. Consequently, the data analysis method used to substantiate the model should be a method used in conducting associative analysis (i.e., relative risk, odds ratios, non-causal correlation).

Focus of Literature Review

The focus of this literature review is twofold. First, this review will inform the reader of current research regarding high school science teachers in the areas of professional activity, job satisfaction, and mobility. This part of the literature review elaborates in three specific sections the theoretical perspectives and practical considerations regarding individual teachers and the schools in which they teach. Second, this review will discuss the data analysis methods used by researchers in developing current understanding of three areas of high school science teacher research (e.g., professional development, job satisfaction, mobility). This second part of the literature review will focus on the commonality of specific data analysis methods, potential benefits and deficits of each method, and a specific method (i.e., relative risk) rarely used by education researchers.

Current Research Regarding Teacher Professional Activities

Regardless of the profession, all members of a profession participate in professional activities. These activities can include professional development (Moskvina, 2006; Garet, Porter, Desimone, Birman, & Yoon, 2001), recruitment and mentorship of new members (Penlington, 2007; Koballa, Bradbury, Glynn, & Deaton, 2008), and leadership (McDonald, 2008). Although similar across professions, professional activities are modified according to the specifications of the individual profession (Okoye, Momoh, Aigbomian, & Okecha, 2008; Penuel, Fishman, Yamaguchi, & Gallagher, 2007) and the needs of its members (see Table 3) (Day, 2008; Huang & Fraser, 2009).

TABLE 3
Three Professional Activities Modified for the Education Profession

Professional activity	Modified activity in education profession	Teacher need	Example(s) of activity
Development	Teacher professional development	Develop personal knowledge, both content and pedagogy, in teaching	One day workshops, summer institutes, graduate programs
Maintenance	Teacher mentorship	Maintain, and if necessary improve, standards of teaching practice	Teacher-teacher dialogue, Peer teaching
Management	Teacher leadership	Manage both classroom and general aspects of the teaching profession	Science department head, curriculum developer

A broader understanding of the high school science teacher population can be achieved by analyzing the professional activities of high school science teacher samples. Analysis of these teacher's activities allows stakeholders, including education policy makers, to make informed decisions regarding current or future policy relating to specific activities (Feng, 2005; Moskvina, 2006; White, Gorard, & See, 2006). For example, participation in teacher professional activities reveals an individual's potential commitment to (Day, 2008) and expertise in (Okoye et al., 2008) the teaching profession. These relationships suggest that policy makers should consider implementing policy that supports teachers' involvement in professional activities.

Discussion of teacher professional activities must be placed within the context of an increasingly intensive and results-driven environment of education policy (Day, Elliot, & Kington, 2005). This environment is designed to raise teaching standards, increase student learning, and enhance school effectiveness (Day, 2008). In this environment, some authors state that power has shifted from individual teachers to principals, district leaders, and education policy makers (Huang & Fraser, 2009). At least five observed consequences of the development of this current education environment exist: (1) instruction that "teaches to the test,"; (2) challenges to current norms regarding teacher identity; (3) reduced time for teachers to interact with individual students; (4) threats to teacher agency and resiliency; and (5) challenges to teacher motivation, efficacy and commitment (Day, 2008). In a study of 100 English schools, Day points out three additional consequences relating specifically to teachers: (1) release time from teaching duties for increasing professional knowledge (e.g., professional development), (2) development of more professional activities (e.g., professional maintenance), and (3) increased responsibility for social activities within the profession (e.g., professional management).

Learning theorists contend that teachers' participation in professional activities will lead to increases in student achievement (e.g., Cronbach & Snow, 1977; Day, 2008;

Garet et al., 2001; Moskvina, 2006). This contention is the basis for creating professional development activities for high school science teachers (Okoye et al., 2008). Specific examples of professional development activities for high school science teachers include one-day workshops, summer-long institutes, and extended graduate programs (Garet et al., 2001; Penuel et al., 2007).

Participation in professional development is a common professional activity used to increase the professional expertise of high school science teachers (Day, 2008). Moskvina (2006) provides a theoretical discussion on teacher professional deformation and posits that new teachers are noble, pure of heart, sincere, open-minded, and straightforward. However, over time these teachers become dogmatic, rigid in regard to rules and regulations, less able to effectively communicate with younger generations, and closed to new ideas. Moskvina further contends that these negative personality changes reflect teacher participation in inadequate professional development activities. Moskvina concludes that development of professional speech, a result of participation in development activities, serves to alienate teachers from students and colleagues alike. However, common speech forces teachers to create overly simplistic answers to complex learning questions. Consequently, teachers must learn to think and speak as both a learner and an expert simultaneously. This would suggest that the development and application of teacher professional activities should reflect the needs of both teachers and students.

In discussing the role of mentorship for new science teachers, Luft and colleagues (2007) outlined five specific actions taken by effective teacher-mentors: (1)

listen more, talk less; (2) acknowledge the new teacher's experiences; (3) understand fully what is being said; (4) provide reinforcement in areas of growth and reflection; and (5) follow-up. Each of these actions directly supports the needs of new teachers within logistical, instructional, conceptual, psychological, and philosophical domains. New teachers must develop their expertise within each of these domains to take future leadership roles within the profession (Gold, 1996).

Researchers have also claimed that active engagement in teacher professional activities on the part of current teachers leads to increases in the teacher population (Eick, 2002). This claim supports the belief that recruitment into a profession requires the effort of individuals currently in the profession (Luft, Bang, & Roehrig, 2007). Using current teachers to assist in recruitment of new teachers has led to the development of multiple recruitment strategies involving teachers, including: (1) site-based committees, (2) recruitment trips, and (3) informal visits with prospective teachers (Guarino, Santibanez, & Daley, 2006).

Teacher leadership is a consequence of professional management (McDonald, 2008). McDonald (2008) posits a framework for effective science education leadership in the classroom using five points outlined by the National Science Education Standards: (1) engagement in scientifically oriented questions; (2) evidence based responses to questions; (3) formulation of evidence-based explanation; (4) connections between explanations and scientific knowledge; and (5) communication and justification of explanations (National Research Council [NRC], 2000). McDonald asserts that effective teacher leadership in the classroom requires a leader to provide engagement, require evidence based explanations, and development of conceptual understanding from students. The three components of engagement, requirement, and development expressed by McDonald are found in many of the reviewed articles related to teacher professional activities (Day, 2008; Moskvina, 2006; Penlington, 2007).

Current Research Regarding Teacher Job Satisfaction

Definitions for job satisfaction exist in the fields of human resource management (Brief & Weiss, 2002), public policy (Quarstein, McAfee, & Glassman, 1992), medicine (Scott, Gravelle, Simeons, Bojke, & Sibbald, 2006a) and education (Hean & Garrett, 2001). Although lacking a formal definition, job satisfaction is defined by many researchers as a positive emotional state resulting from evaluation of a job (Brief & Weiss, 2002); an affective reaction to a job (Butt et al., 2005); or an attitude toward a job (Bogler, 2002).

Weiss (2002) argues that, although job satisfaction is an attitude, researchers should clearly distinguish between internal objects of evaluation (i.e., emotion and belief) and external objects of measurement (i.e., behavior). He suggests that individuals form attitudes of satisfaction, either positive or negative, towards their jobs by a combination of internal cognitive processes and external actions.

Theories and Models of Job Satisfaction. Research in job satisfaction can be traced back to the Hawthorne studies (Mayo, 1946) conducted by the Harvard Business School. The primary focus of these studies was to identify the effects of various working conditions on worker productivity. The general conclusion from these studies was that changes in working conditions can lead to temporary increases in productivity. Mayo’s results laid the foundation for the development of subsequent job satisfaction theories and models, including Locke's Range of Affect Theory, Dispositional Theory, Herzberg's Two-Factor Theory, and Hackman and Oldham's Job Characteristics Model (see Table 4).

TABLE 4
Comparison of Four Major Job Satisfaction Theories and Models

Theory or model	Theoretical perspective	Data characteristics	Analysis methods	Internal factors	External factors
Affect theory (Locke, 1969)	Organizational psychology	Non-polar scale Multiple factors	Factor analysis	Very important	Not important
Dispositional theory (Bandura, 2000)	Personnel management	Polar scale Multiple factors	Factor analysis	Very important	Not important
Two-Factor theory (Herzberg, 1966)	Combines Affect and Dispositional	Polar or non-polar scales 0 to 1 is most common	Frequency, percentage, SEM, HLM	Important	Somewhat important
Job characteristics model (Hackman & Oldham, 1976)	Focuses on external factors	Dichotomous or Likert scale	Frequency, percentage, SEM, HLM	Not important	Very important

Locke's Range of Affect Theory (1969) posits that job satisfaction is determined by the difference in what workers want from their job and what they in actuality receive. Additionally, the theory states that the value of a given aspect of their job (e.g., relationships with co-workers, autonomy, salary, social status) can affect how satisfied or dissatisfied one becomes when an expectation is met. For example, when a person values a particular aspect of a job, his job satisfaction increases when his expectations related to that aspect are positively acted upon, by either him or others. Job satisfaction also can decrease when the reverse occurs. To illustrate, a teacher's job satisfaction is increased from the autonomy he experiences in making decisions about his classroom teaching, which is directly supported by his current school administration. New school practices designed to reduce the teacher's autonomy that may be initiated by a new school administrator, however, can reduce the teacher's job satisfaction. Finally, Range of Affect Theory proposes a combinatory effect. Specifically, the more value placed on a particular job aspect receiving positive reinforcement combines with positive ancillary interactions leading to higher job satisfaction.

Dispositional Theory (Bandura, 2000) suggests that people have innate dispositions that cause individuals to have tendencies toward a certain level of satisfaction regardless of their current employment. Judge and Bono (2001) further refined Dispositional Theory with the Core Self-Evaluation Model. According to Judge and Bono, an individual's self-esteem, self-efficacy, locus of control, and general mental health are cognitive processes linked to job satisfaction. Consequently, both authors support the idea that job satisfaction is a primary function of internal cognitive health. This idea suggests that workers having good mental health are likely to experience job satisfaction, regardless of the job.

Herzberg's Two-Factor Theory explains both job satisfaction and motivation simultaneously (Hackman & Oldham, 1976; Herzberg, 1966). This theory states that satisfaction and dissatisfaction are caused by factors described as motivation (e.g., internal) and hygiene (e.g., external). According to the theory, motivation to work is related to the job satisfaction of a subordinate. Motivation is presented as an internal force driving individuals to attain personal and/or organization goals (Porter, Wrench, & Hoskinson, 2007). Motivator factors are those aspects of the job that make people want to perform, which, in turn, provide themselves and others with satisfaction. Examples of motivational factors include achievement in work, recognition, and opportunities for promotion. These factors are considered to be intrinsically linked to a specific job (Hackman & Oldham, 1976). In contrast, hygiene factors include those aspects of the external working environment common to all jobs. Examples of hygiene factors include pay, policies and practices, and working conditions. While Herzberg's theory has influenced much research, researchers have been unable to give empirical evidence in support of the theory (Hackman & Oldham, 1976). Furthermore, by assuming all employees react in a similar manner, the theory does not consider individual differences.

Hackman and Oldham (1976) proposed the Job Characteristics Model (JCM) as a framework for studying how particular job characteristics influences job satisfaction of individuals (see Figure 4). The model proposes five core job characteristics (skill variety, task identity, task importance, autonomy, and feedback) influencing three psychological states (experienced meaningfulness, experienced responsibility, and knowledge of actual results), that influence job satisfaction. A meta-analysis by Fried and Ferris (1987) provided empirical support for the validity of the Job Characteristics Model. Specifically, Fried and Ferris’s analysis supported Hackman and Oldham’s contention that the three psychological states (e.g., experienced meaningfulness, experienced responsibility, and knowledge of results) were significant mediators of an individual's job satisfaction.

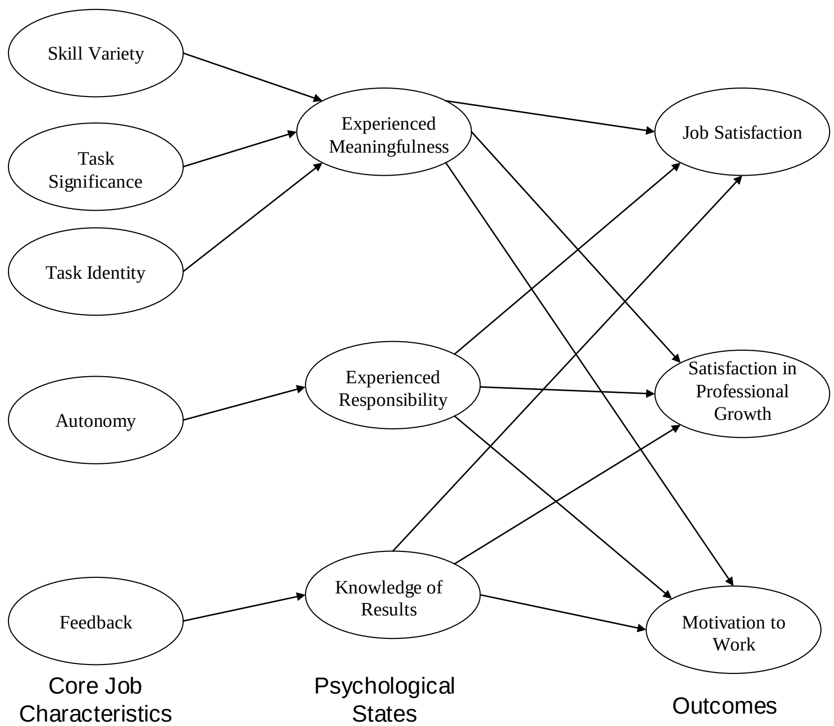

FIGURE 4. *Hackman and Oldham's Job Characteristics Model.*

Obtaining and Measuring Job Satisfaction. Survey instruments are the most common method for obtaining job satisfaction data. Researchers create survey instruments for specific populations (Weiqi, 2007), modify existing instruments (Hean & Garrett, 2001), or conduct secondary analyses of data obtained from previously collected survey data (Liu & Ramsey, 2008). The use of a few instruments, however, has been sustained over time. The *Job Descriptive Index* (JDI; -(Balzer, Kihm, Smith, Irwin, Bachiochi, Robie, Sinar, & Parra, 1997), *Minnesota Satisfaction Questionnaire* (MSQ ;Hirschfield, 2000), *Job Satisfaction Survey* (JSS; Spector, 1985), and *Faces Scale* (Wanous, Reichers, & Hudy, 1997) are examples of instruments commonly used in research studies investigating cognitive, behavioral, and situational aspects of job satisfaction.

The JDI, created by Smith, Kendall, and Hulin (1969), is one of the first survey instruments used to measure job satisfaction. It measures an individual's satisfaction regarding five factors. The measurement scale is binary, having participants answer either yes or no in response to statements written as description of an individual's job. The MSQ is currently a popular instrument measuring 20 job satisfaction factors. The MSQ has a 100-item long form and a 20-item short form using a Likert scale. The JSS (Spector, 1985) is a 36-item questionnaire measuring nine job satisfaction factors. The Faces Scale of job satisfaction (Wanous, Reichers, & Hudy, 1997) measures overall job satisfaction with just one item that participants respond to by choosing a face. However, a survey instrument designed explicitly for secondary science teachers did not exist before the Policy Research Initiatives in Science Education (PRISE) research group created the Texas Poll of Secondary Science Teachers (TPSST).

Research in Education, High School Education, and High School Science Education

Regardless of school level or teacher content domain, most studies of teacher job satisfaction use some variation of Hackman and Oldham's JCM. Either Locke's Affect (Bolin, 2007; Hean & Garrett, 2001; Weiqi, 2007) or Dispositional Theory (Butt et al., 2005; Kearney, 2008) also influence these studies.

Education. Job satisfaction in education research has been studied as an overall construct (Zigarelli, 1996) as well as a series of individual factors (Bogler, 2002) related to teacher attitude. The majority of articles reviewed for this dissertation focus on factors related to teacher attitude. The major factors identified as contributing to teachers' job satisfaction are working with students, challenge of teaching, and autonomy (Block, 2008; Bogler, 2002; Hean & Garrett, 2001; Kearney, 2008; Skaalvik & Skaalvik, 2009). Butt et al. (2005) noted that salary and benefits showed weak relationships with overall teacher job satisfaction. Both Bishay (1996) and Weiqi (2007) pointed to higher-order needs related to social interrelationships as the primary source of teacher job satisfaction. These authors suggest that teachers' job satisfaction is not related to salary, policies and practices, or working conditions. Consequently, their conclusions diminish the role of Herzberg's hygiene factors. As further evidence to support the diminished effectiveness of Herzberg's theory to explain teacher job satisfaction, Sturman and Short (2000) found that teachers exhibit higher levels of job satisfaction than other professionals do. The authors concluded that the working life of teachers (i.e., balance between work and non-work life), learning environment of schools (i.e., working with students), and a sense of familial or close collegial relationships within schools (i.e., collaborating with teachers) allowed teachers to experience higher levels of job satisfaction.

Researchers have also studied relationships between teacher demographic variables and job satisfaction (Bogler, 2002). Plihal (1982) found a positive correlation between a teacher's years of experience with job satisfaction while teachers in rural schools exhibited less job satisfaction than those in suburban schools (Haughey &

Murphy, 1984; Ruhl-Smith, 1991). Additionally, a large number of studies suggest female, more than male, teachers possess higher levels of job satisfaction (Chapman & Lowther, 1982; Kearney, 2008; Watson, Hatton, Squires, & Soliman, 1991). Finally, race appears to play a role in job satisfaction as well. Kearney (2008) reported European American teachers expressed significantly lower levels of job satisfaction than their African American colleagues did.

High School Education. Researchers have documented differences in job satisfaction for teachers across school levels (e.g., elementary, middle, and high school) (Klassen & Anderson, 2009; Liu & Ramsey, 2008). Wilson (1999) discussed the need for education professionals to consider the school as a community of social functions as opposed to simply a learning community. However, Hargreaves (2002) is one of many researchers who do not believe a high school can operate as a familial or close collegial environment (Butt et al., 2005). The consensus among most researchers is that teachers in elementary schools experience higher levels of job satisfaction (Bogler, 2002) than either middle or high school teachers (Bolin, 2007). Consequently, much of the research regarding satisfaction in high school education considers the structure of school as a driving factor in teacher job satisfaction (Weiqi, 2007).

Early research on teacher mobility in high school education found salary, age, gender, content area, and academic ability as contributing factors (Boe, Bobbitt, Cook, Whitener, & Weber, 1997; Ingersoll, 2001; Johnson, 1990; Murnane, Singer, Willett, Kemple, & Olsen, 1991). Consequently, teacher mobility in high schools is possibly another factor in teacher job satisfaction research (Liu & Ramsey, 2008). The problem with these findings is that much of the comparative analysis did not account for differences in attrition and migration or school needs and characteristics (Liu & Ramsey, 2008; Weiqi, 2007).

High School Science Education. The majority of large-sample (i.e., research with more than 30 subjects) research in the area of high school science teacher satisfaction does not divide teachers into specific content areas. As a result, few large sample empirical studies of job satisfaction exist that are specific to high school science teachers. Hean and Garrett (2001) studied 47 Chilean secondary science teachers. They found that the majority of teachers surveyed indicated the greatest sources of job satisfaction as relationships with administrators, colleagues, and students, opportunities to influence future generations, and opportunities to influence individual students. Conversely, frequency analysis of teacher data indicated the greatest sources of job dissatisfaction as (1) salary, (2) excessive workload, (3) resources, (4) infrastructure, and (5) student characteristics. These results present evidence in support of Locke's Affect Theory. Specifically, relationships formed within a school and the opportunity to teach may be experienced by all teachers regardless of content area or school level. However, Murnane et al. (1991) provide evidence that disparity in salary was a factor in high school science teacher attrition and job satisfaction, which supports Herzberg's Two-Factor theory (e.g., increasing a hygiene factor like salary will increase job satisfaction while reducing teacher mobility).

Current Research Regarding Teacher Mobility

Education policy is viewed as a means for addressing teacher mobility (Day, Elliot, & Kington, 2005). Policy attempts to produce positive student, teacher, and school outcomes (i.e., high student achievement, low teacher attrition, positive learning environment within the school). The need for recruiting individuals to teach in United States classrooms is likely to increase in the near future. The National Center for Educational Statistics (NCES) has reported that the public school student population will increase by approximately four percent during a ten year period ending in 2014 (Hussar, 2005). Additionally, at least half of all states now have some form of policy or program in place that decreases teacher-student ratios (e.g., decreased ratios from one teacher per 30 students to one teacher per 24 students; see Education Commission of the States, 2005). Finally, with passage of the *No Child Left Behind Act of 2001* (NCLB) many states are beginning to address current and future teacher's certification and content knowledge standards (Cohen-Vogel & Smith, 2007; Elfers, Plecki, & McGowan, 2007; Hirsch, Koppich, & Knapp, 2001). The combination of these factors has led many education researchers to study the general issue of teacher mobility (Feng, 2005; Luekens, Lyter, & Fox, 2004; Macdonald, 1999) and high school science teacher mobility specifically (Eick, 2002; Ingersoll, 2006).

Defining Measures of Teacher Mobility. Teacher mobility research views retention from either the school or the education professional workforce. Consequently, it is necessary to delineate which view is predominant when assessing research. The term "stayer" (Smith & Ingersoll, 2004) describes those teachers retained by the individual school. Likewise, the terms “mover” (Ingersoll, 2001) or “migrator” (Feng, 2005) describes a teacher who remains in the education workforce but has left one school to teach in another. Finally, “leaver” (Ingersoll, 2001) describes the attrition of a teacher from the education professional workforce.

Three Major Research Fields for Teacher Mobility. In reviewing literature related to teacher mobility, three major research fields were identified: (1) teacher characteristics affecting teacher mobility (Eick, 2002; Liu & Johnson, 2006); (2) school characteristics affecting teacher mobility (Borman & Dowling, 2008; Mont & Rees, 1996; Weiss, 1999); and (3) methods for retaining teachers (Dolton & van der Klaauw, 1999; Feiman-Nemser, 2001; Ingersoll, 2001; Scott, Milam, Stuessy, Blount, & Bentz, 2006b; White, Gorard, & See, 2006). These fields of research draw upon one another to build models explaining teacher mobility (Feiman-Nemser, 2001; Ingersoll, 2006), identify factors determining teacher mobility (Feng, 2005), and offer solutions for recruiting teachers into the workforce (Scott et al., 2006) or stemming the loss of teachers from the workforce (Feiman-Nemser, 2001). Figure 5 (see the next page) presents this three-way, symbiotic relationship with examples from literature.

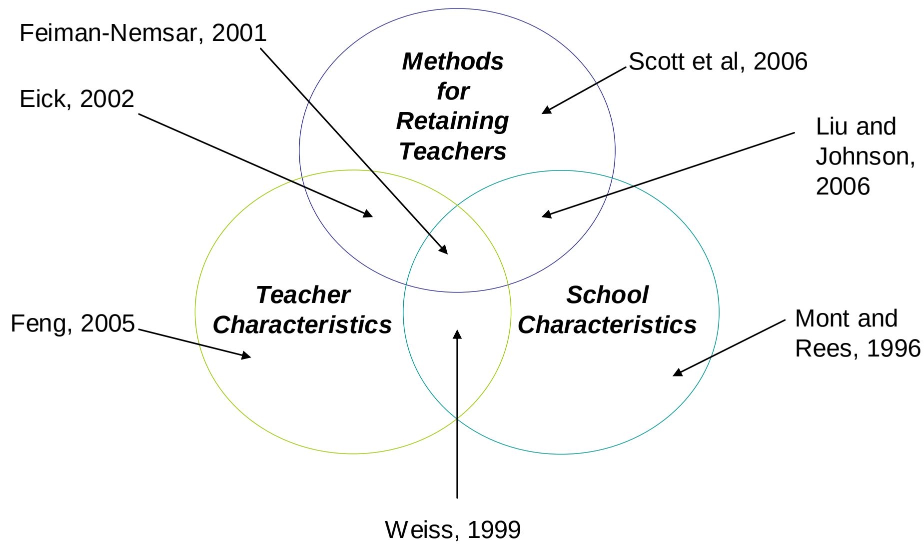

FIGURE 5. *Interaction of teacher retention research fields in the literature.*

Teacher Characteristics Affecting Teacher Mobility. Feiman-Nemser (2001) makes the point that the quality of a nation's schools depends on the teacher population within those schools. Prior research indicates that teachers who are female, have lower cognitive ability, come from lower socio-economic backgrounds, or do not teach in the sciences are more likely to stay in the classroom (Heyns, 1988; Murnane, Singer, & Willettt, 1989). However, with recent changes in national level education policy, specifically NCLB, much effort has been expended in educational research to identify teacher characteristics linked to teacher mobility. These characteristics are generally grouped into larger categories described as teacher commitment and abilities.

Teacher Commitment. Coladarci (1992), in his studies of teacher mobility, describes teacher commitment as the psychological attachment to the teaching profession. Teacher commitment is generally studied by asking teachers whether they would still choose a teaching career or identifying common characteristics of teachers who leave the teaching profession (Fresko, Kfir, & Nasser, 1997). Darling-Hammond (1990) found that teacher commitment was highly correlated to job satisfaction, a finding which has greatly influenced current theory regarding the relationship between teacher job satisfaction and teacher mobility (Eick, 2002; Farber, 1991).

Teacher Abilities. Podgursky, Monroe, and Watson (2004) found evidence suggesting that teachers with high ACT test scores are more likely to leave the classroom. Heyns (1988) suggested that teachers with higher cognitive abilities working in high performing schools are also more likely to leave the profession. Additionally, White and colleagues (2006) provided evidence to support their conclusion that teachers having scientific or mathematical abilities are more likely to leave the classroom before retirement. However, Eick (2002) found that an early interest in science along with a desire to increase science knowledge in others and themselves were indicators for choosing the education profession and remaining in either a specific school or the profession.

School Characteristics Affecting Teacher Mobility. School characteristics assumed to affect teacher mobility include student quality, class size, school size, salary schedules, and leadership (Liu & Johnson, 2006; Mont & Rees, 1996; Weiss, 1999). Many researchers use these variables in constructing empirical models to explain teacher mobility (Mont & Rees, 1996; Weiss, 1999). For example, Guarino et al. (2006) found that large urban schools with high student minority populations employed teachers who were more likely to leave for teaching opportunities in different schools or to leave the profession entirely. Additionally, Murnane and Olsen (1989) found that increasing teacher salaries by as little as $1,000 led to a median increase of four years in teacher retention. Finally, Somech and Bogler (2005) discovered evidence indicating better retention rates in schools with leadership styles that allowed teachers to participate in decisions affecting school programs and practices.

Methods for Retaining Teachers. Since the publication of *A Nation at Risk* in 1983, most states have increased the number of science courses required for high school graduation (Smith, 2004). In addition, passage of NCLB has increased pressure on schools to hire teachers in high school science classrooms who are "highly qualified" (Ingersoll, 2006). In response, science education researchers and practitioners have focused on methods for retaining teachers before entering the classroom (Scott et al., 2006). Scott and colleagues (2006) developed a program for recruiting high school science teachers still in college. Developed at a large university to recruit and develop potential science and mathematics teachers, the program uses structured field experiences to acclimate future teachers to the process of working with adolescent learners. The program also uses a series of financial incentives (i.e., tuition waivers, fee waivers, and scholarships) and mentoring services to address issues of recruiting and retaining future teachers before entering the classroom. These same incentives and services are found in literature related to in-service teacher retention (Eick, 2002; Feiman-Nemser, 2001; Feng, 2005; Liu & Johnson, 2006).

Feiman-Nemser (2001) presents the case that a systematic method of teacher support can effectively increase teacher retention. These methods include both teacher-teacher supports and teacher-administration supports. Teacher-teacher supports mentioned in the literature include development of science-learning professional communities, teacher mentorship, and socialization outside the school environment (Borman & Dowling, 2008; Eick, 2002; Feiman-Nemser, 2001; Kardos et al., 2001). Teacher-administration supports include improvement of working conditions, increased salaries, increased teacher autonomy, reduced class sizes, childcare provisions, and medical care (Borman & Dowling, 2008; Feng, 2005; Macdonald, 1999; Murnane, Singer, & Willettt, 1989).

Data Analysis Methods

The remainder of this literature review will briefly discuss some of the quantitative data analysis methods used in the reviewed articles. A review of these methods are important as making substantive statistical comparisons between groups has become important for education researchers studying teacher professional activity, job satisfaction, and mobility. Liao (2002) writes that “the nature of doing science, be it natural or social, inevitably calls for comparison. Statistical methods are at the heart of such comparison, for they not only help us gain understanding of the world around us but often define how our research is to be carried out” (p. XV). Liao further writes that statistical methods are most effective when researchers obtain data through causal experimentation. However, an associative hypothesis using proper statistical procedures provide conclusions that are just as valid as those provided through the use of causal experimentation (Wright, 2006).

Methods chosen by researchers to analyze data can significantly affect conclusions, as well as interpretations by consumers and applications by policymakers of research. A review of 20 articles related to teacher professional activity, job satisfaction, and movement published since 1999 indicates six types (see Figure 6 and Table 5) of quantitative data analysis methods in the field. For the purposes of this review, a seventh data analysis method (e.g., relative risk) not observed in the reviewed articles will be discussed.

Each data analysis method mentioned in this review has both strengths and weaknesses (see Table 6). While the purpose of this review is not to discuss in detail each strength and weakness for the identified data analysis method, the remainder of this review will elucidate some of the common strengths and weaknesses associated with each method using examples from the reviewed articles.

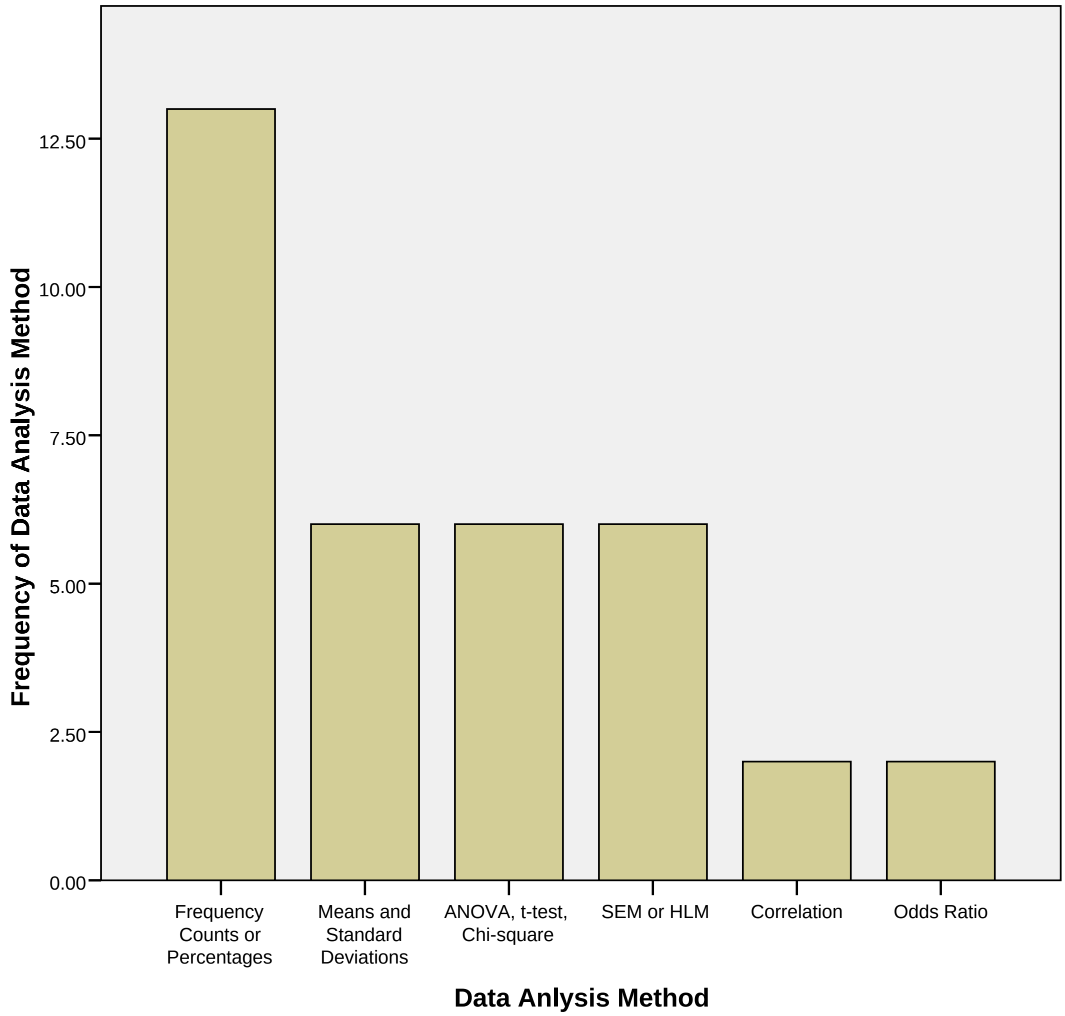

FIGURE 6. *Frequency of data analysis methods used by researchers' in 20 reviewed articles.*

TABLE 5
Types of Quantitative Data Analysis Methods Used in Teacher Professional Activity, Job Satisfaction and Mobility Research

Data Analysis Method	Examples
Frequency counts and percentages	Hean and Garrett (2001), Day (2008)
Means with SD	Leukens, Lyter, and Fox (2004), Butt et al., (2005)
ANOVA, t-test, χ^2	Liu and Johnson (2006), Mont and Rees (1996)
SEM or HLM	Huang and Fraser (2009), Penuel et al. (2007)
Correlation	Bolin (2007)
Odds ratio	Borman and Dowling (2008)

TABLE 6
Strengths and Weaknesses of Quantitative Data Analysis Methods Observed in the Literature

Data Analysis Method	Strengths	Weaknesses
Frequency counts and percentages	Simple to present and understand	Easy to misinterpret and over-generalize
Means and SD	Simple to present and understand	Easy to over-generalize
ANOVA, T-test, and χ^2	Easy to form generalizations	Easy to form false causal relationships
SEM or HLM	Easy to identify relationships of nested data sources	Difficult to interpret Easy to form false causal relationships
Correlation	Easy to identify relationships using all data measurement scales	Easy to form false causal relationships

TABLE 6 continued

Data Analysis Method	Strengths	Weaknesses
Odds ratio	Easy to calculate strength of associative relationships	Can only be used with qualitative data
Relative risk	Easy to calculate strength of associative relationships	Can only be used with qualitative data

Frequency Count and Percentage. The most common data analysis method observed in the articles was frequency count and percentages (13 out of 20). This analysis method is fundamental to many other methods. The strength of this method is its simplicity. For example, Hean and Garrett (2001) reporting on sources of job satisfaction for Chilean secondary school science teachers is an excellent example of how frequency counts and percentages can yield clear understanding of research conclusions. The authors provide both the number of teachers surveyed and percentages of responses to specific questions related to the research protocol. Frequency counts and percentages do have a weakness, however. False conclusions can be reached by comparing percentages across different categorical groupings. For example, Day (2008) presented a series of percentages for teachers having different years of experience to support the conclusion that teacher attitudes differ based on years of teaching experience (see Figure 7). However, using a more complex method on Day's data, the chi-square test of independence, fails to support the conclusion. The Chi-square test of independence tests the hypothesis that two categorically measured variables (i.e., teacher experience level and impact on student progress) are independent. Using data from

Figure 7, the chi-square test (df = 4, χ^2 = 2.868) fails to reject the hypothesis that teacher attitude and experience level are independent.

Mean with Standard Deviation. When researchers discuss mean scores with standard deviations, they often refer to the sample means and standard deviations (SD). Education researchers often use a sample mean score (y-bar or x-bar) in the place of a population mean score (μ). This practice is useful as it is often impossible to calculate population mean scores for a series of variables. As with frequency counts and percentages, reporting means with SD is a fundamental analysis method whose strength is simplicity. Six out of 20 reviewed articles cited sample means with SD. A mean score provides a standard or "average" value. For example, Butt et al. (2005) make the point that secondary teachers, on average, work almost 50 hours each week. The 50-hour workweek is based on the sample means of 49.9 (n = 477) and 49.1 (n = 421) calculated from two separate teacher samples. The discussion associated with this article uses the two mean values as a focus for the specific conclusions reached by the authors. However, the authors fail to provide SD values. Without the SD to describe the variability of the mean scores, it is impossible to know the accuracy of the claim that teachers, on average, work 50 hours each week.

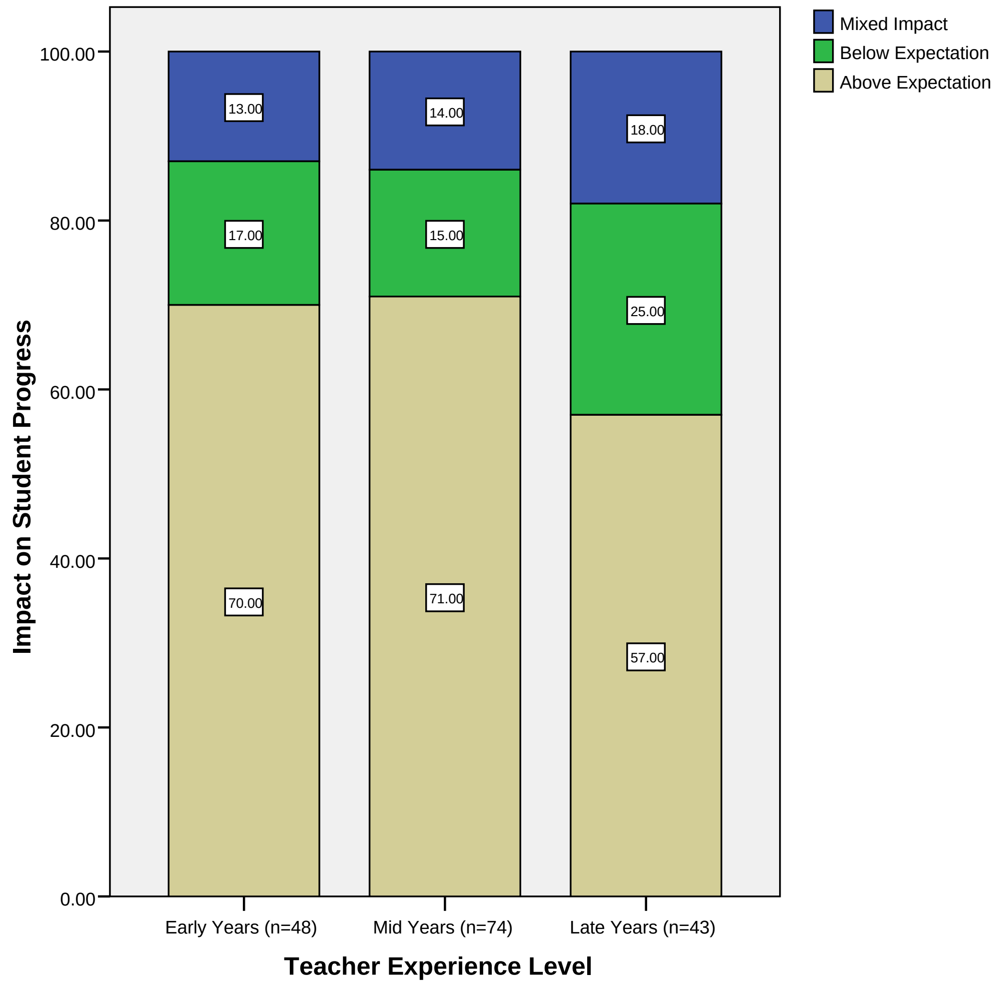

FIGURE 7. *Teacher perception of impact on student progress (from Day, 2008).*

ANOVA, t-test, and χ^2. The ANOVA, t-test, and χ^2 are three common data analysis methods used in determining differences for some score between two (t-test, χ^2) or more (ANOVA, χ^2) groups. The ANOVA and t-test are commonly associated with continuous level scores across categorical groupings of data, whereas χ^2 is commonly associated with categorical level scores across categorical groupings. Regardless of the method, variability within groupings is held to be larger than variability across groupings. Consequently, these tests rely heavily on the variance within and between groupings. For the articles reviewed, these methods of analysis were as common as means with SD (6 out of 20).

Liu and Johnson (2006) studied the experience of hiring procedures for new teachers. These researchers report that differences in the percentage of teachers hired more than one month before school started were significantly different across states. Specifically, a Pearson χ^2 statistic, the most common χ^2 test of independence, was calculated to test the null hypothesis that the responses of teachers were independent by state (see Table 7). The use of the statistic allowed researchers to make the claim that new teachers in Florida (18.6%) are least likely to be hired one month before the start of school when compared to teachers in California (35.8%), Massachusetts (51.1%), and Michigan (58.0%). Additional data analysis indicated that new teachers in California (34.5%) or Florida (35.4%) were more likely to be hired after the school year when compared to teachers in Massachusetts (13.5%) or Michigan (9.5%). However, Liu and Johnson made the error of using percentages instead of count data to conduct the test. For example, the Pearson χ^2 value for Day's data in Figure 7 using percentages (df = 4, χ^2 = 5.729) increases the likelihood of rejecting the null hypothesis of independence by 100 percent when compared to the χ^2 value using count data (df = 4, χ^2 = 2.868).

TABLE 7
Timing of Hiring for New Teachers in Four US States as Provided by Liu and Johnson

Variable	All States	California	Florida	Massachusetts	Michigan
Percentage of teachers hired more than a month before school started	36.1%	35.8%	18.6%	51.1%	58.0%
Percentage of teachers hired after the school year started	33.0%	34.5%	35.4%	13.5%	9.5%

SEM and HLM. Two techniques commonly used in theory development or testing are structural equation modeling (SEM) and hierarchical linear modeling (HLM). The development of SEM began in the field of genetics (Wright, 1921). The ability to use both categorical and continuous level data simultaneously within SEM make it a useful tool in education research. Factor analysis, path analysis, and linear regression are examples of SEM. The greatest strength of SEM is the ability to create latent variables (e.g., variables not measured directly but implied by measuring other variables) for model development.

HLM, or multilevel analysis, is a popular data analysis method in education research (Osborne, 2000). An advanced form of SEM, HLM's popularity is a result of the fact that the objects of teacher policy studies (e.g., teachers) are nested within classrooms and schools. Multilevel analysis allows the researcher to build linear models that take into account the nesting of individual data within organizational levels. For the articles reviewed, these methods of analysis were as common as means with SD (6 out of 20).

The use of SEM requires careful inspection of the relationships between B and β values. Specifically, if a small change in B yields a significant β value the researcher must take into account the measurement system for the significant variable as well as the 95% confidence interval. For example, Hulpia et al. (2009) make the claim that job satisfaction for secondary teachers is negatively correlated (β = -0.134) to years of classroom experience. In this example, job satisfaction is the latent variable of interest whereas years of job experience is the measured variable. In the example of Hulpia et al., the B value for job experience's influence on job satisfaction is only -0.008. Therefore, although the β value is statistically significant, it is difficult to substantiate the claim of practical significance as the corresponding B value indicates little linear influence on the latent variable, job satisfaction. Additionally, the authors do not provide any information related to the confidence interval. In nonprofessional terms, this SEM indicates that teacher job satisfaction is reduced by 0.008 for each year spent in the classroom. However, with no information regarding the scale of job satisfaction measurement the consumer is left to wonder if 0.008 is a significant change in job satisfaction over time.

Liu and Ramsey (2008) used an HLM method to model the teacher latent variable job satisfaction. The model developed from the analysis indicated an average job satisfaction score of 3.60 on a scale from 1 to 5 (see Table 8). Results from the analysis indicated that teachers ranked job satisfaction areas from most to least satisfied in the following order: safety (4.14), administration (3.60), student interaction (3.36), resources (3.26), professional development (3.10), compensation (2.99), and working

TABLE 8
Parameter Estimates for Unconditional Job Satisfaction Model Presented by Liu and Ramsey

Parameter	Intercept	Job safety	Admin.	Student interaction	Resources	PD	Comp.	Working conditions
Parameter Estimate	3.60	4.14	3.60	3.36	3.26	3.10	2.99	2.92

conditions (2.92). These values indicated that job satisfaction is higher or equal to the average score (e.g., 3.60) in areas of safety and administration but lower in all other areas of researcher interest. Consequently, the authors made the claim that positive feelings regarding job safety and administration relationships increase teacher job satisfaction whereas the remaining areas (e.g., student interaction, resources, professional development, compensation, and working conditions) decrease job satisfaction. Further analysis indicated (1) small gender differences, (2) large minority differences, (3) moderate experience differences, and (4) moderate teacher mobility differences in teacher job satisfaction (see Table 9).

Correlation. Whereas SEM and HLM are complex data analysis methods, the simplest method relating a single dependent variable (Y) to a single independent variable (X) is the correlation method. The use of correlation values are embedded within most modern data analysis methods (e.g., factor analysis, regression, and chi-square). Correlation values measure the strength and direction of the relationship between any two variables. Commonly linked with analysis of two variables measured on a

TABLE 9
Differences in Teacher Job Satisfaction for Conditional Models Presented by Liu and Ramsey

Model condition	Job safety	Admin.	Student interaction	Resources	PD	Comp.	Working conditions
Gender	Males higher	No difference	Females higher	No difference	No difference	No difference	Males higher
Minority status	Whites higher	Whites higher	Whites higher	Whites higher	Minority higher	Whites higher	No difference
Experience	No difference	Increasing difference	Increasing difference	Increasing difference	Increasing difference	Increasing difference	Increasing difference
Stayer – Leaver	No difference	Stayers higher	Stayers higher	No difference	Stayers higher	No difference	No difference
Stayer – Mover	Stayers higher	Stayers higher	Stayers higher	Stayers higher	No difference	Stayers Higher	No difference

continuous scale (e.g., Pearson's r), correlation values can also be calculated for relationships involving variables measured on a categorical scale (e.g., Spearman's rho and Kendall's tau). The use of correlation values as a method for data analysis occurred in only a few of the reviewed articles (2 out of 20).

Bolin (2007) used correlation values to measure the relationship of the independent variables of age, teaching experience, and education with the dependent variable job satisfaction (see Table 10). In his final analysis, Bolin made the claim that age and teaching experience were significantly correlated to job satisfaction. Specifically, as teachers age they become more satisfied in terms of job satisfaction. However, these correlations are based on latent and not measured variables.

Consequently, the correlation values presented violate the assumptions for calculating correlation values, specifically that each value should be a measured variable.

TABLE 10
Quantitative Values Presented by Bolin Linking Age and Length of Teaching Service to Job Satisfaction

Measured variable	Self-fulfillment	Work intensity	Salary	Leadership	Collegial relationships
Age	0.24***	-0.15 **	0.26***	-0.01	0.16**
Length of teaching service	0.21***	-0.10 *	0.27***	-0.01	0.16**

* - Correlation is significant at $p < 0.10$.

** - Correlation is significant at $p < 0.05$.

*** - Correlation is significant at $p < 0.01$.

Bolin's analysis contradicts claims made by Hulpia et al., (2009). Consequently, readers of both articles must make decisions regarding the validity of each author's claims. At issue is not whether the choice of data analysis method is correct. The issue is whether the steps taken in the research protocols (e.g., hypothetical framework) substantiate the use of the data analysis method. Consequently, although each author made contradictory claims regarding the relationship between a teacher's age and classroom experience with job satisfaction, they could both be correct given that certain characteristics of the research protocols (i.e., sampling) or populations (i.e., cultural) are dramatically different.

Odds Ratio. The odds ratio (OR) calculates the odds of an event occurring given the presence of another variable (Cohen, 2000), where each variable is measured on a binary scale (i.e., yes-no, on-off, stay-go). A major strength of an OR is that it treats the two variables symmetrically. This means that the researcher can calculate ratios without making statements regarding causality. Additionally, although designed for random samples, the OR can be used as an effect size measure analogous to Pearson's r. Like the use of correlations, the OR is not frequently used in the articles reviewed (2 out of 20).

Borman and Dowling (2008) used the OR to determine the role of teacher experience in attrition. The results from their analysis indicate that the odds of leaving the profession for teachers having 5 or 6 years of experience were 1.57 greater, or 57% greater, than for teachers having less than 5 years of experience. These results contradict the commonly held belief that teachers in the first three years of service are at greater risk of leaving the profession (Ingersoll, 2006). However, the OR calculated by Borman and Dowling were used as an effect size for data retrieved from a series of articles. Consequently, further analysis of the research protocols used in the retrieved articles would be necessary before assuming that Borman and Dowling's conclusion is valid.

Relative Risk. A relative risk (RR) value measures the likelihood of an event occurring given that one of two groups is exposed to a single event (Cohen, 2000). None of the reviewed articles used this method in data analysis. RR is commonly used in medical research because patients with similar medical conditions (i.e., presence of heart disease) can be classified according to risk behaviors (i.e., smoker or nonsmoker). For example, Maddox et al. (2008) used the method in a study of angina (e.g., chest pain) occurrence one year after myocardial infarction (e.g., heart attack). Results from the study indicate that patients experiencing angina were 23 percent more likely to be smokers.

Studies of teacher mobility (e.g., stayers, movers, and leavers) would allow education researchers to identify the risk of teacher mobility given teacher exposure to a specific professional development activity (e.g., did or did not participate in the activity) (see Table 11). Risk analysis of data in Table 11 indicates that a teacher classified as retained is 5.571 times (30/35 / 10/65) as likely to be a teacher mentor as a teacher classified as migrated. Consequently, a researcher can make the claim that a high degree of association exist between teacher retention and teacher participation in mentorship.

TABLE 11
Example of a Relative Risk Data Table Using a Teacher Professional Activity (e.g., Teacher Mentor) and Mobility Status for 100 Teachers

	Teacher Mentor		
Mobility Status	Yes	No	Totals
Retained	30	5	35
Migrated	10	55	65
Totals	40	60	100

Conclusions

Changes in the American high school science education system over the last hundred years have increased the importance of the high school science teacher. For many people, a science teacher is the individual most responsible for imparting scientific literacy. Additionally, these teachers are fundamental in developing the future generation of natural and physical scientists. Consequently, as the world faces the 21st century, the role of the high school science teacher becomes ever more important.

The question of how to maintain past gains in the education system while seeking to improve that system has neither a single nor a simple response. The answers to the question may be discovered in the complex relationships found between three areas of education research: student achievement, teacher professionalism, and school culture (Darling-Hammond, 1999; Kardos, Johnson, Peske, Kauffman, & Liu, 2001; National Commission on Teaching and America’s Future, 1997; Smith, 2004; Stuessy, Bozeman, & Ivey, 2010). Science education researchers often view these relationships causally (Elfers et al., 2007; Skaalvik & Skaalvik, 2009). Meaning, positive changes in one area *cause* positive changes in the larger system (see Figure 8). However, an associative model can also offer insight into these relationships (Borman & Dowling, 2008; Day, 2008; Dolton & van der Klaauw, 1999).

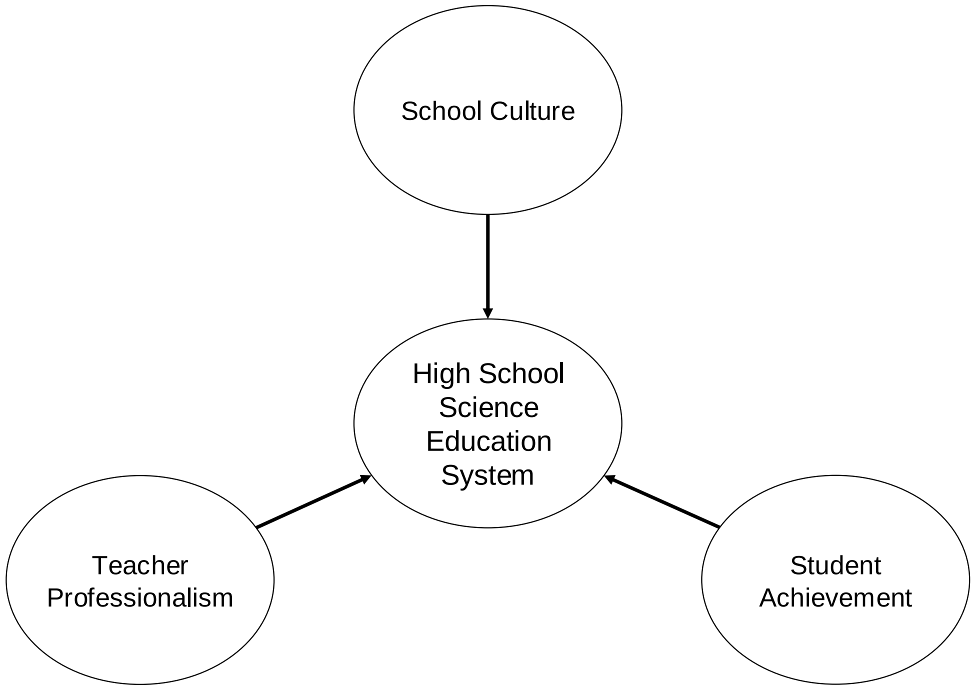

FIGURE 8. *A causal model explaining relationships between areas of high school science education research.*

One method for answering the question of how to improve the science education system can be achieved by associatively studying relationships between specific latent and measured teacher variables (see Figure 9). It is probable that relationships between teacher professional activity, job satisfaction, and mobility are linked to the larger system described in Figure 8. Therefore, by studying relationships between teacher participation in professional activity, current job satisfaction, and mobility it may be possible to provide answers to the question of improving the high school science education system while maintaining past gains.

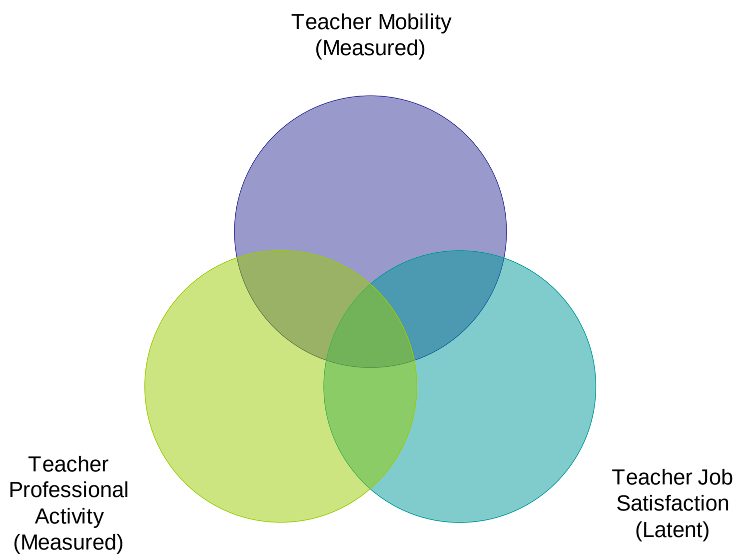

FIGURE 9. *A second look at the associative relationship between teacher mobility, professional activity, and job satisfaction.*

CHAPTER III

PARTICIPATION IN PROFESSIONAL ACTIVITIES BY HIGH SCHOOL SCIENCE TEACHERS: PREVALENCE AND ASSOCIATED FINDINGS WITH TEACHER RETENTION

In response to concerns about student achievement, many countries and U.S. state governments have implemented standards-based education policies (Day, 2008; Papay, Murnane, & Willettt, 2010; Smith, 2004). Those reform policies related to science education have enjoyed a particularly lively emphasis with many documents outlining what should be taught by teachers and learned by students (American Association for the Advancement of Science [AAAS], 1993; National Research Council [NRC], 2000). Recent research and policy indicate the critical role of "highly qualified" science teachers in achieving the goals outlined in reform science education policy (Okoye, Momoh, Aigbomian, & Okecha, 2008; *No Child Left Behind Act*, 2001; Spybrook & Raudenbush, 2009). Research also provides evidence that experienced teachers exhibit superior professional skills over their inexperienced counterparts (Darling-Hammond, Berry, & Thoreson, 2001) and that teachers with strong science backgrounds are better able to implement the content standards described in reform policies (Desimone, Porter, Garet, Yoon, & Birman, 2002).

While reform policies continue to mandate better student achievement in science, little attention has been given to the development of policies for assuring both teacher professional learning (Boyd, Grossman, Lankford, Loeb, & Wycoff, 2009) and retention

(Donaldson & Johnson, 2010). Mandates for professional learning vary to include suggestions, recommendations, and state-mandated master's degrees achieved within five years of certification. In addition, few policies exist specifically aimed at retaining science teachers, particularly in states lacking intervention from organized teachers' unions or possessing a large potential teacher population. Unfortunately, in many states teacher professional learning and retention standards have not paralleled their reforms for student learning (Darling-Hammond, Berry, & Thoreson, 2001). Nor has the relationship between professional learning and retention been fully investigated or substantiated.

Teacher Retention, Professional Activities, and Research Questions

The current education policy environment has created a school classroom that is intensive and results-driven (Day, Elliot, & Kington, 2005) and has led many researchers to contend that power has shifted from classroom teachers to school principals, district leaders, and politicians (Huang & Fraser, 2009). At least five observed consequences of this environment have been identified: (a) instruction that "teaches to the test"; (b) challenges to current norms regarding teacher identity; (c) reduced time for teachers to interact with individual students; (d) threats to teacher agency and resiliency; and (e) challenges to teacher motivation, efficacy and commitment (Day, 2008). In a study of 100 English schools, Day pointed out three additional consequences relating specifically to teacher participation in professional activities: (a) release time from teaching duties for increasing professional knowledge, (b) responsibility for developing more and diverse professional activities, and (c) increased participation in social activities within the profession.

Teacher Retention

The effect of the current policy environment on teacher retention is uncertain. However, teacher retention has been a point of much research (Allensworth, Ponisciak, & Mazzeo, 2009; Ingersoll, 2001). Current estimates indicate that between one-third and one-half of all new teachers leave their school and/or the profession before completing five years of service (Borman & Dowling, 2008; Ingersoll, 2001). For example, a recent study by the Policy Research Initiatives in Science Education (PRISE) research group estimated that half of all new Texas high school science teachers leave their school or the profession within five years (Stuessy, Bozeman, & Ivey, 2009). Furthermore, researchers have concluded that teacher retention is associated with increased levels of student achievement, coordination of curriculum reform, and savings of both monetary and non-monetary resources (Donaldson & Johnson, 2010). Thus, there is a need to understand teacher retention and identify potential associations with other aspects of the profession. One aspect, whose association with retention is still poorly understood, is teacher participation in professional activities.

Professional Activities

As part of the standards-based policy movement in the last century, many U.S. states made policies affecting teacher professionalism. For example, prior to 1999, the state of Texas awarded teachers a lifetime teaching certificate after passing initial state certificate examinations. However, on September 1, 1999 Texas legislators replaced the

Lifetime Provisional certificate with the five-year Standard certificate. The new certificate requires all Texas classroom teachers to complete at least 150 continuing professional education (CPE) hours during each five-year renewal period. Types of CPE activities considered acceptable include:

1. participating in institutes, workshops, conferences, or staff development;
2. completing graduate coursework;
3. developing curriculum;
4. teaching a CPE; and/or
5. providing professional guidance as a mentor (Texas Education Agency [TEA], 2010).

The existing empirical studies of teacher participation in the professional activities listed above are limited in scope. These studies generally focus on describing the activities themselves (Penuel, Fishman, Yamaguchi, & Gallagher, 2007) or the net effect on student achievement (Okoye et al, 2008; Spybrook & Raudenbush, 2009). Consequently, in the current policy environment our knowledge about the prevalence of teacher participation in specific activities is limited.

Categorizing Professional Activities. Although similar across professions, professional activities are modified according to the specifications of the individual profession (Okoye et al., 2008; Penuel et al., 2007) and the needs of its members (Day, 2008; Huang & Fraser, 2009). The *No Child Left Behind Act of 2001* (NCLB) describes effective teacher professional activities as advancing teachers' understanding of effective teaching strategies discovered through scientific research on teacher-classroom environments. Day categorized professional activities to include three major distinctions: development (Garet, Porter, Desimone, Birman, & Yoon, 2001; Moskvina, 2006), maintenance (Koballa, Bradbury, Glynn, & Deaton, 2008; Penlington, 2007), and management (McDonald, 2008). Table 12 presents categories of professional activities described by Day (2008).

TABLE 12
A Review of Three Professional Activity Categories Modified for the Education Profession

Professional activity[1]	Comparative term in education profession	Teacher need	Examples
Development	Professional development	Develop both content and pedagogy knowledge	One day workshops, Summer institutes, and Graduate programs
Maintenance	Mentorship	Maintain or improve standards of teaching practice	Teacher dialogue and Peer teaching
Management	Leadership	Manage both classroom and general aspects of the profession	Department head and Curriculum writer

[1]Categories described by Day (2008).

Professional Development. Professional development activities provide teachers the opportunity to increase expertise in their profession (Day, 2008; Okoye et al., 2008). In their discussion of professional development activities, Desimone et al. (2002) hypothesized that six key features of development activities could be effective in improving teacher practice. The first three features are related to structure – is the activity structured to increase opportunities for reform, such as a study group, or is it a traditional workshop; what is the duration of the activity, including contact hours for the teacher; and does the activity emphasize the participation of teachers from the same school, content area, and/or grade level or is the activity for individual teachers from indiscriminate schools. Desimone et al. describes the remaining three features of professional development activities as "core" features. These features reflect substance – is the participant engaged in a significant analysis of their teaching and potential role in student learning; is the activity consistent with teacher goals and current standards; and is increasing teacher content knowledge an end goal for teacher participation.

Professional Maintenance. Professional maintenance activities provide teachers the opportunity to either maintain or improve current standards of teaching within a school or the profession (Gold, 1996). Correnti (2007) notes that many policies implemented during the standards-based era were failed attempts to improve student learning by improving standards of teaching practice in individual schools. The failure of past policies to improve teaching practice within schools, according to Correnti, was a result of limited resources available for teacher learning. However, some researchers have asserted that activities designed to maintain or improve standards of teaching practice have less to do with availability of conventional resources such as money, facilities, or experienced faculty and more to do with how resources are coordinated among teachers to improve standards of practice (Cohen, Raudenbush, & Ball, 2003). Although professional development activities focus on the individual teachers' growth as a teacher, professional maintenance activities focus on the relationships experienced by teachers within the individual school or the professional community (Correnti, 2007).

Professional Management. Professional management activities provide teachers the opportunity to develop leadership within the classroom, a school and/or the profession (Penlington, 2007). McDonald (2008) asserts that effective teacher leadership in the classroom requires a teacher to engage students; demand evidence-based explanations from students; and develop conceptual understanding with students. These requirements of effective classroom leadership describe professional management activities (Day, 2008, Moskvina, 2006; Penlington, 2007). Management is a function typically completed by a school administrator; however, this hierarchical relationship between administrator and teacher is a result of the importation of the factory model of the industrial age (Goldstein, 2004). Consequently, many teachers today have developed a view of professional management between teachers as intrusive (Feiman-Nemser & Floden, 1986). Where professional development activities focus on the individual teacher and maintenance activities on relationships, professional management activities focus on leadership in the classroom, school or profession.

Research Questions

The effect of policies designed to increase teacher professionalism on retention is still under debate (Darling-Hammond, Berry, & Thoreson, 2001; Goldhaber & Brewer, 2001). I used the PRISE sample of 385 Texas high school science teachers to examine the prevalence of teacher participation in 29 specific professional activities. I then conducted a comparative analysis using three categorical measures of teacher retention (e.g., Stayer, Mover, and Leaver). Finally, I investigated the associative relationships between teacher participation in professional activities and two measures of teacher retention (e.g., Retained by the school and retained in the profession). Specifically, in this chapter I addressed the following four research questions:

Research Question 1: What is the prevalence of teacher participation in professional development, maintenance, and management activities?

Research Question 2: Does teacher participation in professional activities differ across classifications of teacher retention?

Research Question 3: What are the associations between teacher participation in professional development, maintenance, and management activities with the decision to remain at a school?

Research Question 4: What are the associations between teacher participation in professional development, maintenance, and management activities with the decision to remain within the profession?

Purpose of the Study and Method

An experienced and professional teaching population is associated with measures of student achievement (Darling-Hammond, Berry & Thoreson, 2001; Okoye et al., 2008). The purpose of this study is to understand the prevalence of teacher participation in professional activities and the relationship between participation in professional activities and retention. To assess the prevalence of high school science teacher participation in professional activities and examine the associative relationship between participation and retention, I compiled data previously collected from the PRISE research study. The PRISE study used a probability sample of 385 teachers situated in 50 Texas high schools. Teacher data for my study is archived in the PRISE Teacher Database. The Teacher Database contains seven datasets (see Table 13). I used data archived within the Activity and Retention datasets to conduct the research reported in this dissertation.

TABLE 13
Datasets in the PRISE Teacher Database

Dataset name	Archived data
School context	Size, minority status, region, and grades served by teacher's school
Activity	Participation status of teachers in professional activities
Job satisfaction	Satisfaction of teachers with school environment
Certification	Certification(s) possessed by teachers
Schedule	Classes taught by teachers
Teacher context	Demographic data describing teachers
Retention	Retention status of teachers

Sample

The PRISE teacher sample was selected using a multistage probability design. In the first stage of the design, Texas public high schools were stratified using two explicit variables (e.g., size and minority student enrollment proportion) and one implicit variable (e.g., geographic area within the state). This stage resulted in a sample of 50 high schools to represent the population of 1,333 Texas high schools. Administrators from each school were invited to participate in the PRISE research study through either phone contact, face-to-face visits at the school, or during a meeting at Texas A&M University in Fall 2007. From the original sample, 39 school administrators chose to participate. Replacement schools (n = 11) were identified and administrators were contacted in January 2008. Each replacement school administrator agreed to participate in the study. In the second stage of the sampling design, all teachers responsible for teaching at least one state-defined high school science course within each sampled school was selected for participation.

PRISE researchers identified 385 science teachers within the 50 sampled schools. Data collection for teachers began in February 2008 and continued through May 2008. Imputation of non-response teacher data to teacher participation questions used modal values within school for each non-responding teacher (n = 42). The final operational sample consisted of 385 teachers from 50 schools. Table 14 presents the final retention rates for the teacher sample from the PRISE research study.

TABLE 14
Teacher Survey Return Rates from the PRISE Research Study

School sample status	Total teacher sample	Total surveys returned	Return rate (%)
Original (n=39)	316	280	88.6
Replacement (n=11)	69	63	91.3
Total	385	343	89.1

Measures

Teacher Participation in Professional Activities. To measure teacher participation in professional activities, PRISE researchers created the *Texas Poll of Secondary Science Teachers* (TPSST). The TPSST is a 20-item instrument that identifies teachers' participation in professional activities and levels of satisfaction with specific aspects of the school environment. The TPSST is a valid (Cronbach's alpha = 0.862) and reproducible instrument designed specifically for high school science teachers. Teachers were asked to declare their participation in a series of professional activities grouped into six activity types: new teacher recruitment, new teacher induction, leadership, science-specific professional development, science professional, and general (non-science) professional activities. Measures of individual teacher participation responses (1 = yes, 0 = no) are archived in the Activity dataset of the PRISE Teacher Database. A response of yes indicated a teacher participated in a specific professional activity during the previous 12 months. Conversely, a response of no indicated a teacher had not participated in the activity over the same period. Table 15 provides the list of professional activities on the TPSST, which activities were used in my analyses, and my classification of each activity as development, maintenance, or management.

TABLE 15
Classification of Teacher Professional Activities Used in Analysis

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
New teacher recruitment	Q1A	Conducted formal interviews at the school	Management	Yes
	Q1B	Participated in informal visits with perspective teachers	Management	Yes
	Q1C	Went on recruitment trips outside school	Management	Yes
	Q1D	Attended policy meetings specific to science	Management	Yes
	Q1E	Reviewed job applications	Management	Yes
New teacher induction	Q2A	Assisted with orientation to school policies	Maintenance	Yes
	Q2B	Assisted with classroom management	Maintenance	Yes
	Q2C	Observed a new science teacher teaching a science class	Maintenance	Yes
	Q2D	Modeled teaching for a new teacher	Maintenance	Yes
	Q2E	Provided a new science teacher with a science lesson	Maintenance	Yes

TABLE 15 continued

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
New teacher induction	Q2F	Developed a science lesson with a new science teacher	Maintenance	Yes
	Q2G	Performed formal mentoring duties with a new science teachers	Maintenance	Yes
Leadership	Q3A	Chaired a science department	Management	Yes
	Q3B	Wrote science curriculum	Management	Yes
	Q3C	Sponsored a science club or organization	Management	Yes
	Q3D	Mentored a science teacher	Management	No
	Q3E	Joined or is a member of science teacher professional organization	Management	No
	Q3F	Presented at a science workshop, conference, or training session	Management	Yes
	Q3G	Mentored a non-science teacher	Management	No

TABLE 15 continued

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
Leadership	Q2F	Developed a science lesson with a new science teacher	Maintenance	Yes
	Q2G	Performed formal mentoring duties with a new science teachers	Maintenance	Yes
Professional development	Q3A	Chaired a science department	Management	Yes
	Q3B	Wrote science curriculum	Management	Yes
	Q4C	Participated in strategies for teaching science using the Texas Essential Knowledge and Skills (State standards) PD	Development	Yes
	Q4D	Participated in strategies for teaching students to take state exit exams PD	Development	Yes
	Q4E	Participated in strategies for teaching students with special needs PD	Development	Yes
	Q4F	Participated in strategies for teaching using laboratory PD	Development	Yes

TABLE 15 continued

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
Professional development	Q4G	Participated in strategies for teaching science using inquiry PD	Development	Yes
Science professional	Q5AA	Conducted teacher research on innovative practice in science	Maintenance	Yes
	Q5AB	Conducted peer observation with other science teachers	Maintenance	Yes
	Q5AC	Attended graduate studies in science related field	Development	Yes
	Q5AD	Participated in a science educator study group	Development	Yes
	Q5AE	Participated in science teaching professional association	Development	Yes
	Q5AG	Mentored student teachers preparing to become science teachers	Maintenance	Yes
General professional	Q5BA	Conducted teacher research on innovative practice in content area other than science	Maintenance	No

TABLE 15 continued

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
General professional	Q5BB	Conducted peer observation with other teachers who did not teach science	Maintenance	No
	Q5BC	Attended graduate studies in an academic field not related to science	Development	No
	Q5BD	Participated in an educator study group not focused on science	Development	No
	Q5BE	Participated in teaching professional association that is not science specific	Development	No
	Q5BF	Wrote curriculum in a content area other than science	Maintenance	No

Teacher Retention Status. To determine the retention status of sampled science teachers, the PRISE research group used data archived by the Texas Education Agency (TEA). The TEA archives the career trajectory of every Texas public school teacher. Consequently, PRISE researchers were able to classify the retention status of each teacher identified in the PRISE teacher sample by submitting the names of each teacher to the TEA. Teachers were classified as (a) Stayer, if TEA identified the teacher as being at the same school during both the 2007-2008 and 2008-2009 school years; (b) Mover, if TEA identified the teacher as teaching in different Texas schools between the same two school years; and (c) Leaver, if TEA did not identify the teacher as teaching in a Texas school during the 2008-2009 school year. Retention status for each teacher is archived in the Retention dataset of the PRISE Teacher Database. Table 16 provides the distribution of 385 sampled teachers according to their retention status.

TABLE 16
Frequency Distribution of Teachers Classified as Leaver, Mover, and Stayer (n=385)

Teacher mobility status	Frequency	Percentage (%)	Cum. Percentage (%)
Leaver	53	13.8	13.8
Mover	41	10.6	24.4
Stayer	291	75.6	100.0
Total	385	100.0	

Analytic Approach

I used two analytic approaches. First, to examine the prevalence of teacher participation in professional activities, I conducted frequency analysis on teacher responses to each of the professional activities selected in Table 15. In addition, I used this approach to examine the differences in participation for teachers categorized as Stayer, Mover, or Leaver. Second, to examine the associative strength of teacher participation in professional activities with retention, I calculated the relative risk (RR) statistic. I conducted all analyses and created all figures using SPSS statistical software, release 18.0.

Frequency Analysis. Frequency analysis is a primary analysis technique useful for identifying typical values of variables, checking assumptions for statistical tests, and determining the quality of data. I used frequency analysis to calculate the probability of teacher participation in each of the selected activities in Table 15. I also used this technique to identify probability rates within different teacher retention states.

Relative Risk. The RR statistic describes the likelihood of an event occurring in the presence of a factor to the same event in the absence of that factor. For my study, I considered the retention state of a teacher, either retained at the school (Stayer vs. Mover and Leaver) or in the profession (Stayer and Mover vs. Leaver), as the event and participation in a specific professional activity as a factor. Calculation of the RR statistic requires creating a 2x2 matrix to categorize each study subject within one of the four matrix cells (see Figure 10). Equation 1 on the next page describes the likelihood of a teacher being retained when participating in a specific professional activity. Equation 2 describes the 95% confidence interval (CI) for the RR statistic. If the 95% CI for the RR of a specific professional activity encompassed 1.00, I assumed no significant association between teacher participation in the activity and the corresponding retention state. Table 17 provides an example of the RR statistic. For this example, retained at a school is the event and participated in science educator study group is the factor.

	Event		
Factor	Yes	No	Total
Yes	a	b	a + b
No	c	d	c + d
Total	a + c	b + d	a + b + c + d

FIGURE 10. *A 2x2 matrix describing how data are categorized for calculating the relative risk statistic.*

$$RR = [a / (a+b)] / [c / (c+d)] \quad (1)$$

$$95\%\ CI = \ln(RR) \pm 1.96 * S.E._{\ln(RR)} \quad (2)$$

TABLE 17
The Cross Distribution of Participation in Science Educator Study Group by School Retention Status for 385 Texas High School Science Teachers

	Retained at a school (event)		
Participated in a science educator study group (factor)	Yes	No	Total
Yes	46	7	53
No	245	87	332
Total	291	94	385

Results

Research Question 1: What Is the Prevalence of Teacher Participation in Professional Development, Maintenance, and Management Activities?

The proportions describing teacher participation in professional activities are presented in Figure 11. The panel's top third presents proportions for teachers' participating in professional management activities, the middle third presents proportions for professional maintenance activities, and the bottom third presents proportions for professional development activities. For teacher participation in professional development activities, the proportions ranged from less than 0.10 to approximately 0.80. In addition, similar participation proportions within each of three groups emerged. Group 1 consisted of science teaching, science teaching with technology, science teaching with TEKS and TAKS objectives. These activities represent those development activities in which teachers were most likely to participate. Group 2 consisted of teaching science to special needs students, science teaching with lab, and science teaching with Inquiry. Finally, Group 3 consisted of graduate classes in science, science educator study group, and professional science teacher association. These final activities represent those activities in which teachers were least likely to participate. For maintenance activities, the proportions ranged from less than 0.20 to approximately 0.40. For management activities, the proportions ranged from less than 0.10 to approximately 0.20. The results presented in Figure 11 indicate that teachers are most likely to participate in professional development activities, less likely to participate in maintenance activities, and least likely to participate in management activities.

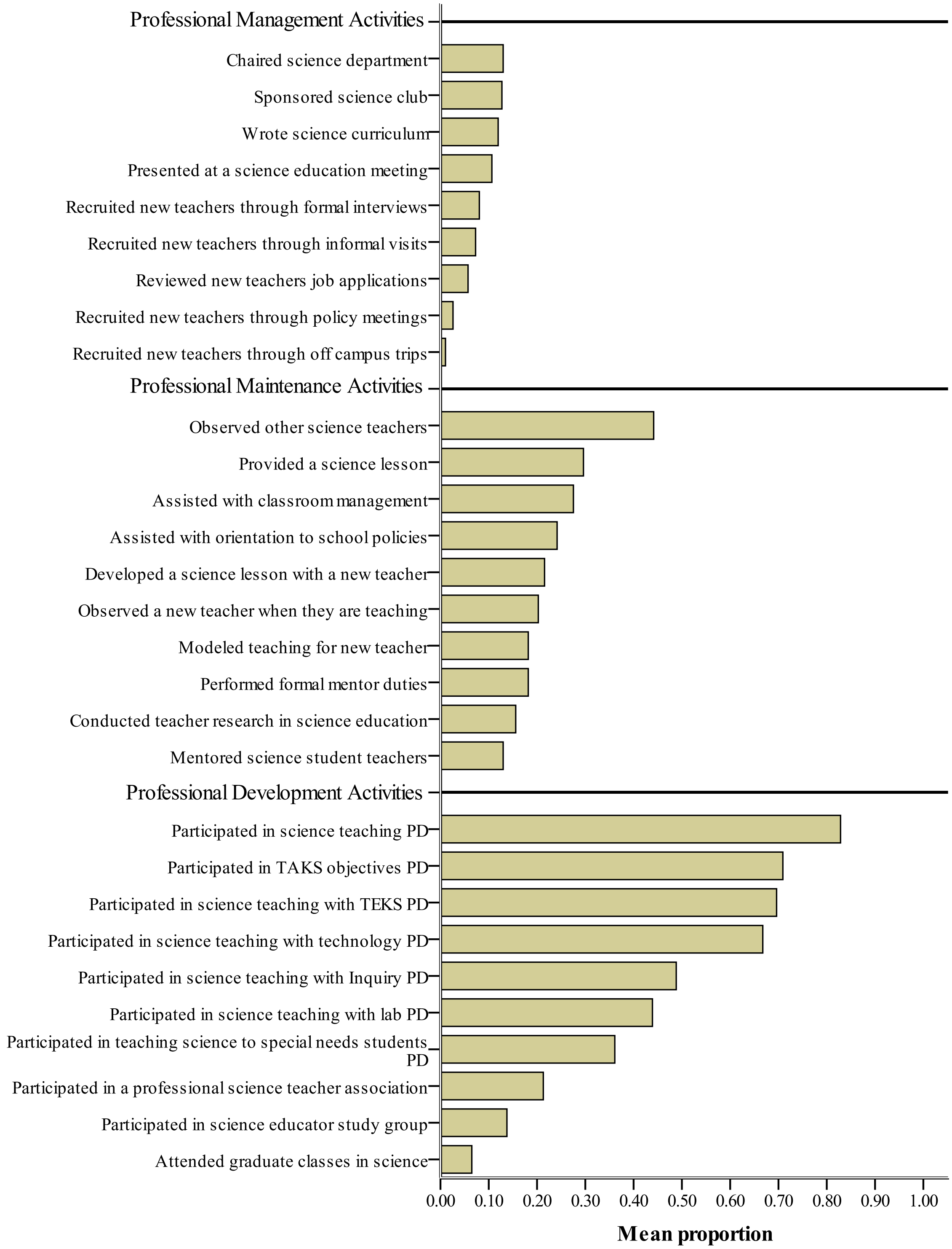

FIGURE 11. *The mean proportion of science teachers (n=385) participating in professional activities categorized as development, maintenance, and management.*

Research Question 2: Do Teacher Participation Rates in Professional Activities Differ across Measures of Teacher Retention?

The proportions of teacher participation in professional development activities by retention status are presented in Figure 12. The figure clearly illustrates the existence of the three groups of professional development activities mentioned previously. However, these proportions suggest that all teachers, regardless of retention status, participate in development activities at similar rates.

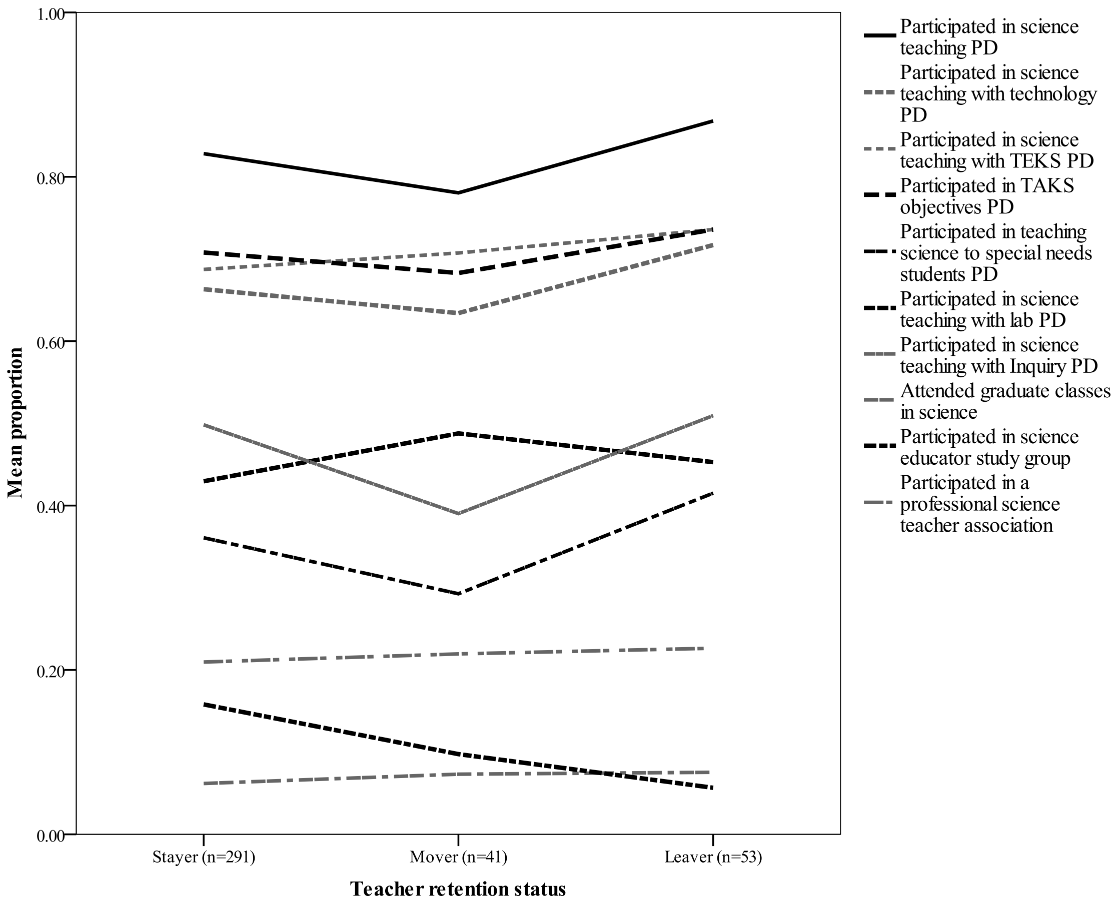

FIGURE 12. *The mean proportion of teachers, by retention status, participating in each one of ten professional development activities.*

The proportions of teacher participation in professional maintenance activities by retention status are presented in Figure 13. The figure illustrates a potential relationship between retention and participation in maintenance activities. Specifically, teachers classified as Stayer are most likely to participate in these activities. By comparison, teachers classified as either Mover or Leaver are less likely to participate in these same activities. The proportions presented in this figure demonstrate that across different teacher retention states participation in maintenance activities likely differs.

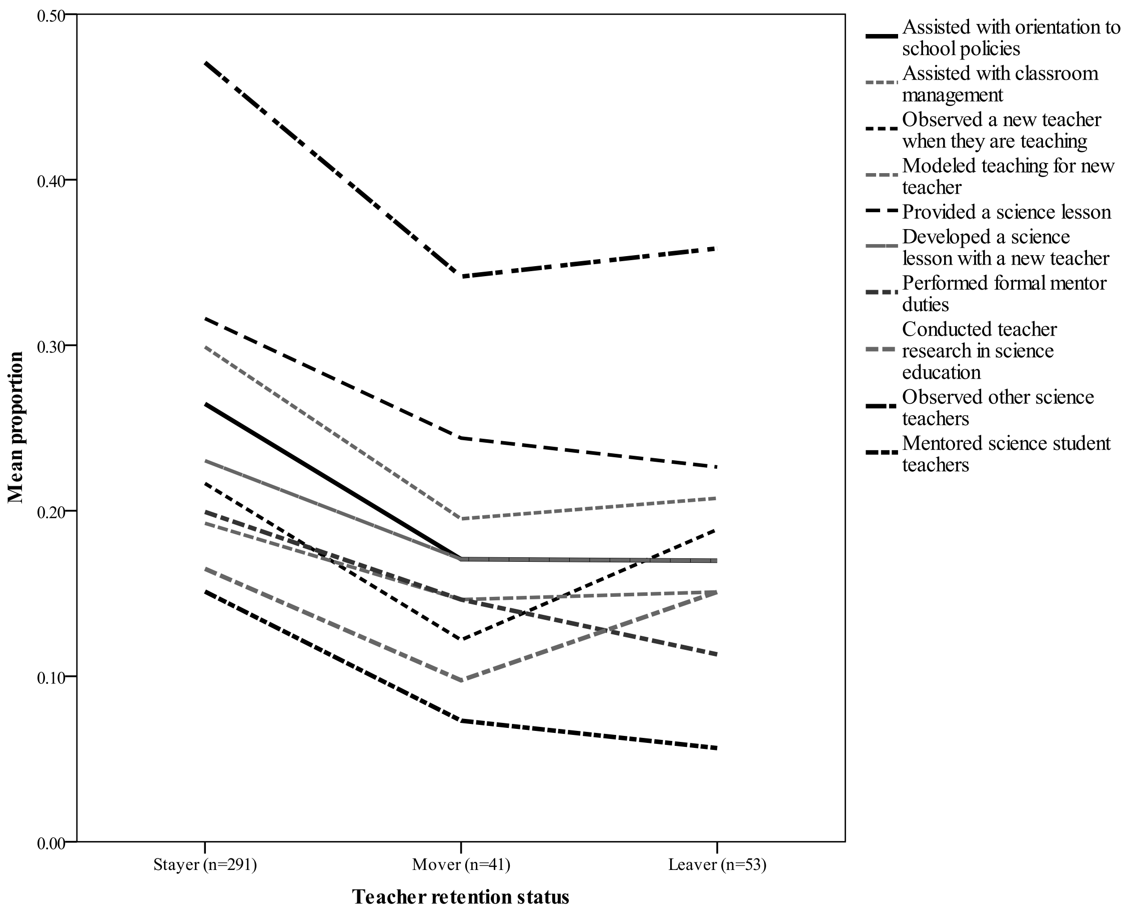

FIGURE 13. *The mean proportion of teacher, by retention status, participating in each one of ten professional maintenance activities.*

The proportions of teacher participation in professional management activities by retention status are presented in Figure 14. This figure shows that a potential relationship between retention and participation in management activities also exists. Specifically, teachers classified as Stayer are most likely to participate in 5 of the 9 activities than their counterparts classified as Mover or Leaver. These five activities include chaired a science department, recruited through off campus trips, recruited through formal interviews, recruited through informal visits, and reviewed job applications.

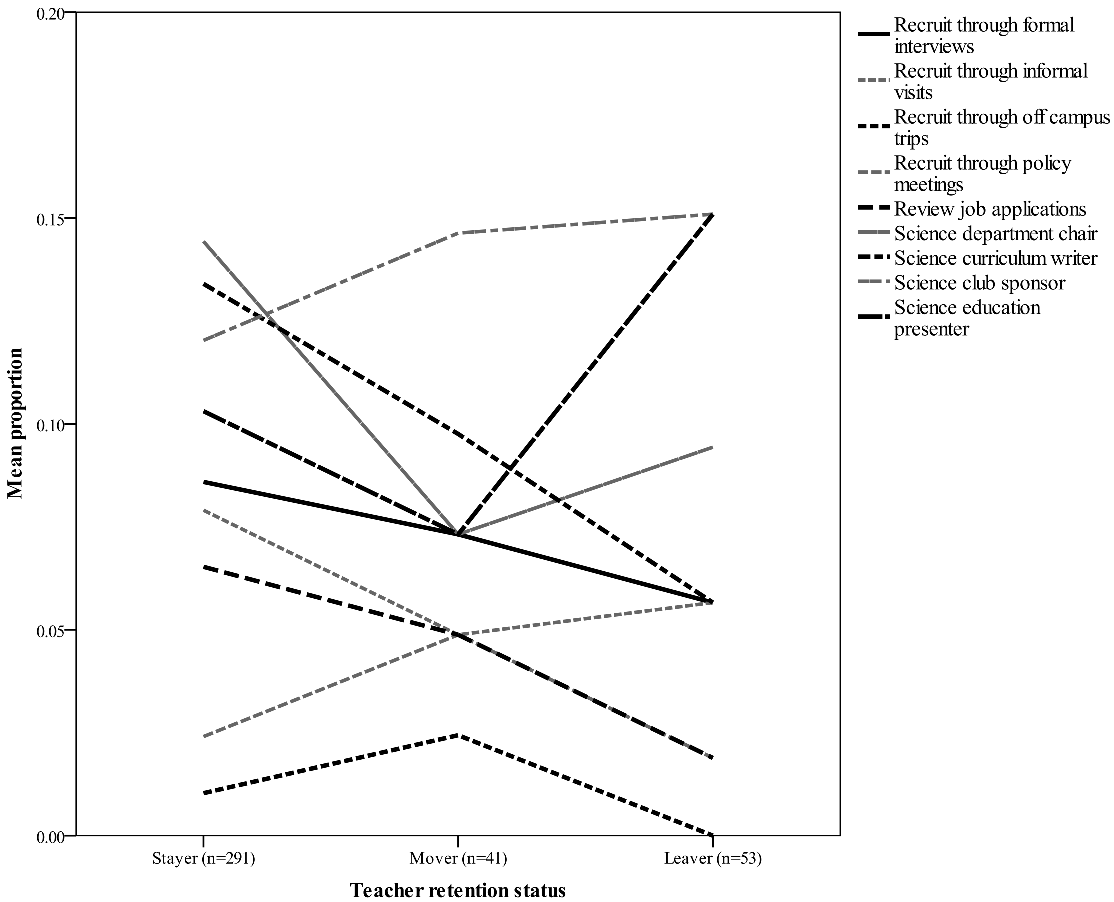

FIGURE 14. *The mean proportion of teachers, by retention status, participating in each of nine professional management activities.*

Research Question 3: What Are the Associations between Teacher Participation in Professional Development, Maintenance, and Management activities with the Decision to Remain at a School?

Overall, teachers are most likely to participate in professional development activities rather than maintenance or management activities. This is evident from results obtained in the first analysis. In addition, results from the second analysis demonstrate that teachers retained by their school are more likely to participate in maintenance activities than teachers who move to another school or leave the profession. In the analyses that follow, I seek to understand the relationship between teacher participation in professional activities and retention. First, I describe the relationship between teacher participation and school retention. Second, I describe the relationship between teacher participation and profession retention. Both analyses use the RR statistic to describe the relationships.

For my analyses, a RR statistic equal to 1.00 describes no relationship between retention and participation in a professional activity. A RR statistic greater than 1.00 describes a positive relationship between teacher participation in a professional activity and retention whereas a statistic less than 1.00 describes a negative relationship. I use a 95% CI to describe the significance of each relationship. If the 95% CI encompasses 1.00 it is not possible for me to definitively describe either the nature (e.g., positive or negative) or the significance of the relationship. For example, the RR describing teachers retained at their school when participating in a science educator study group was estimated as 1.18. The 95% CI for this relationship was between 1.04 and 1.33. These results describe a positive and significant relationship between retention at a school and participation in a study group. Specifically, teachers participating in a study group are 18% (1.18 – 1.00 = 0.18) more likely to be retained at their school than teachers who do not participate in a study group. Additionally, the 95% CI shows that the percentage could be as high as 33% but not less than 4%; therefore I conclude that the relationship is both positive and significant.

Participation in Professional Development Activities and School Retention. Figure 15 presents the relative risk, with 95% CI, of teachers retained at their school as a function of participation in professional development activities. Participation in a science educator study group was the only development activity whose relationship to school retention can be described as both positive and significant. The remaining RR statistics describe no or insignificant relationships between participation in development activities and retention at a school.

Participation in Professional Maintenance Activities and School Retention. Figure 16 presents the relative risk, with 95% CI, of teachers retained at their school as a function of participation in professional maintenance activities. The most striking observation from this figure is the fact that all activities show a positive relationship between teacher participation in maintenance activities and school retention. Furthermore, the RR statistics describing participation in mentoring science student teachers, observing other science teachers, and assisting with orientation to school policies were both positive and significant. These results substantiate the generally held belief that teacher participation in maintenance activities plays a critical role in teacher retention.

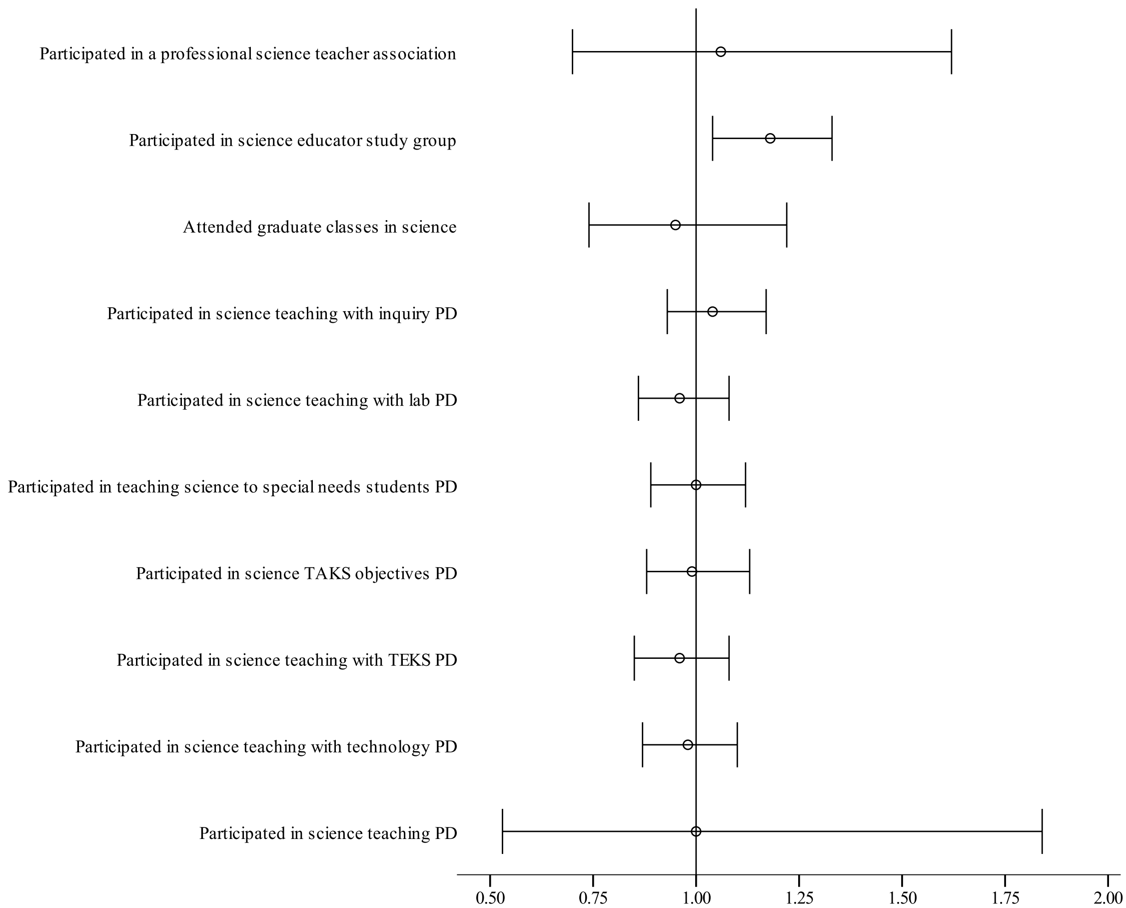

FIGURE 15. *Using the risk statistic to describe the likelihood of teachers being retained at their school when participating in one of ten professional development activities.*

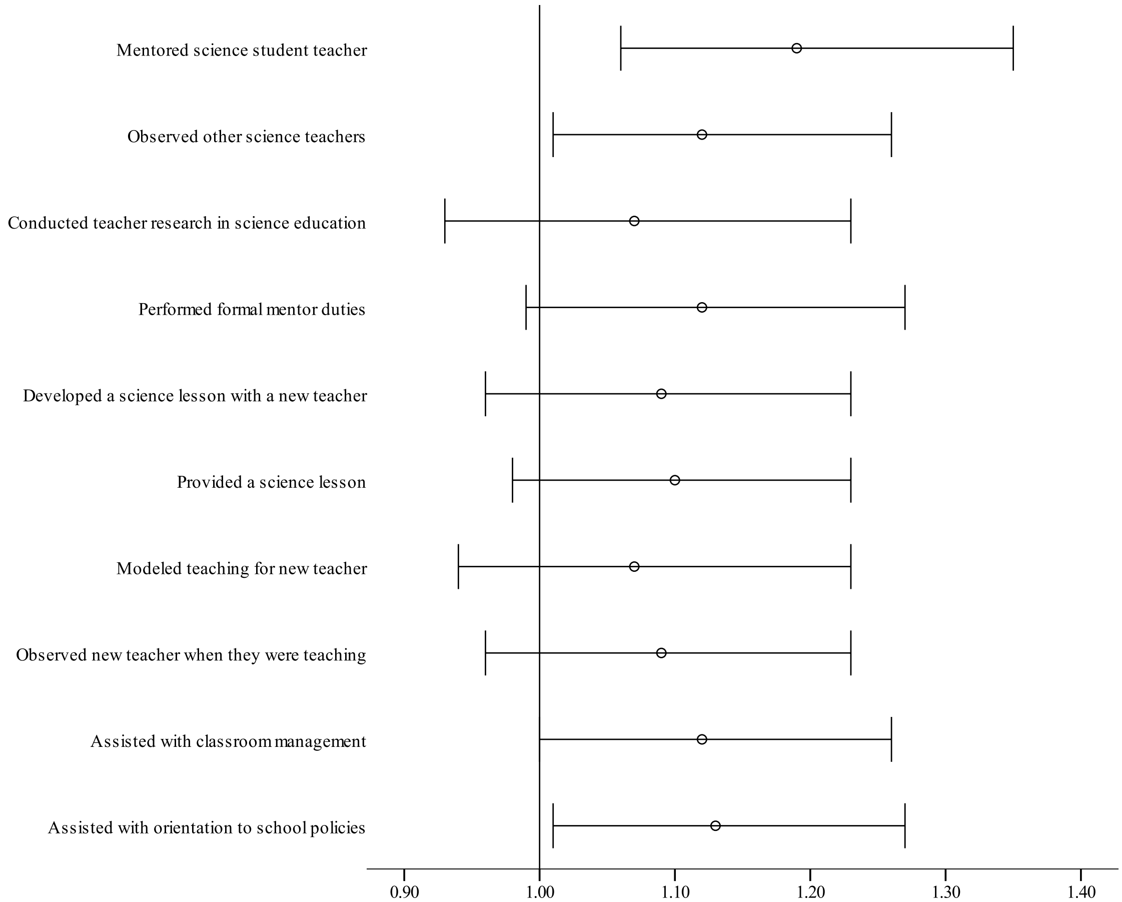

FIGURE 16. *Using the risk statistic to describe the likelihood of teachers being retained at their school when participating in one of ten professional maintenance activities*

Participation in Professional Management Activities and School Retention.

Figure 17 presents the relative risk, with 95% CI, of teachers retained at their school as a function of participation in professional management activities. The statistics illustrated in Figure 17 show that teachers writing science curriculum, chairing science departments, and reviewing new teacher job applications are more likely to be retained at their school. However, these relationships cannot be described as significant because their 95% CIs encompass 1.00. The RR statistics for the remaining management activities describe no apparent relationship between teacher participation and retention.

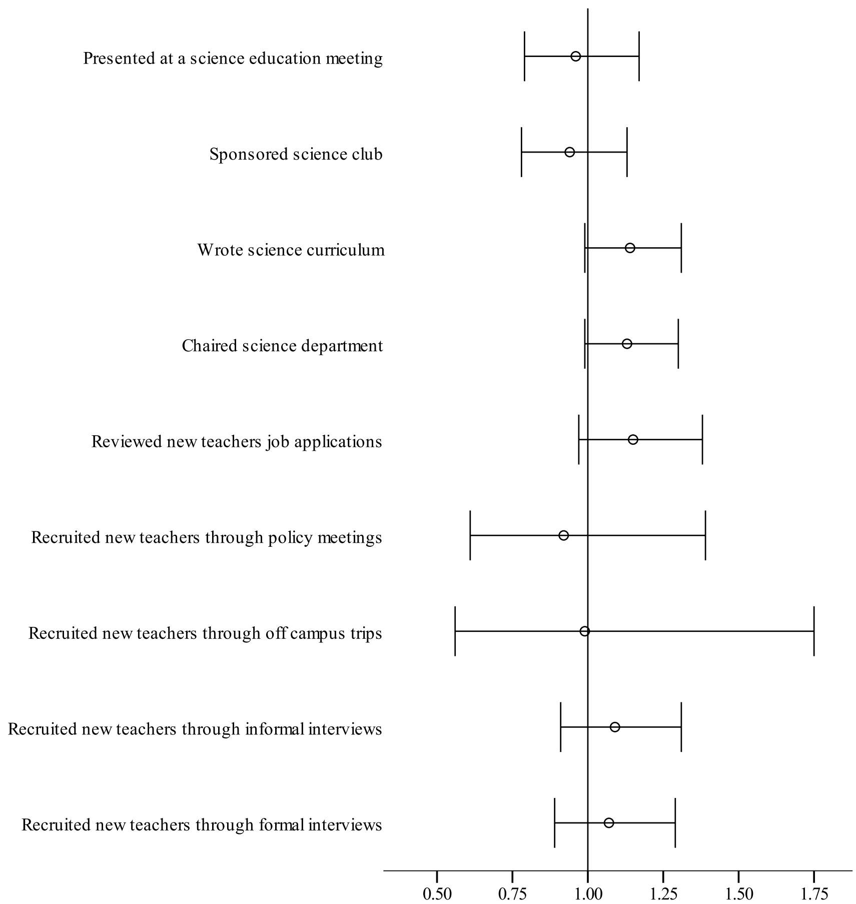

FIGURE 17. *Using the risk statistic to describe the likelihood of teachers being retained at their school when participating in one of nine professional management activities.*

Research Question 4: What Are the Associations between Teacher Participation in Professional Development, Maintenance, and Management Activities with the Decision to Remain within the Profession?

Results from the previous analyses using the RR statistic show that teachers participating in science educator study groups, mentoring science student teachers, observing other science teachers, and assisting with orientation to school policies are significantly more likely to be retained at their school. In addition, teachers participating in any maintenance activity show a greater, though not always significant, likelihood of being retained at their school. These statistics were calculated by comparing teachers categorized as Stayer versus teachers categorized as Mover or Leaver. In the following analyses, I compare teachers categorized as Stayer and Mover versus Leaver. These analyses were conducted to describe the effect of teacher mobility on the relationship between teacher participation in professional activities and retention. Changes in the RR statistic will reflect this effect. For example, increases in the statistic show that teachers who move to another school are more likely to participate in a professional activity than teachers who leave the profession. By contrast, decreases in the statistic show that teachers who leave the profession are more likely to participate in a professional activity than teachers who move to another school.

Participation in Professional Development Activities and Profession Retention. Figure 18 presents the relative risk, with 95% CI, of teachers retained in the profession as a function of participation in professional development activities. These statistics

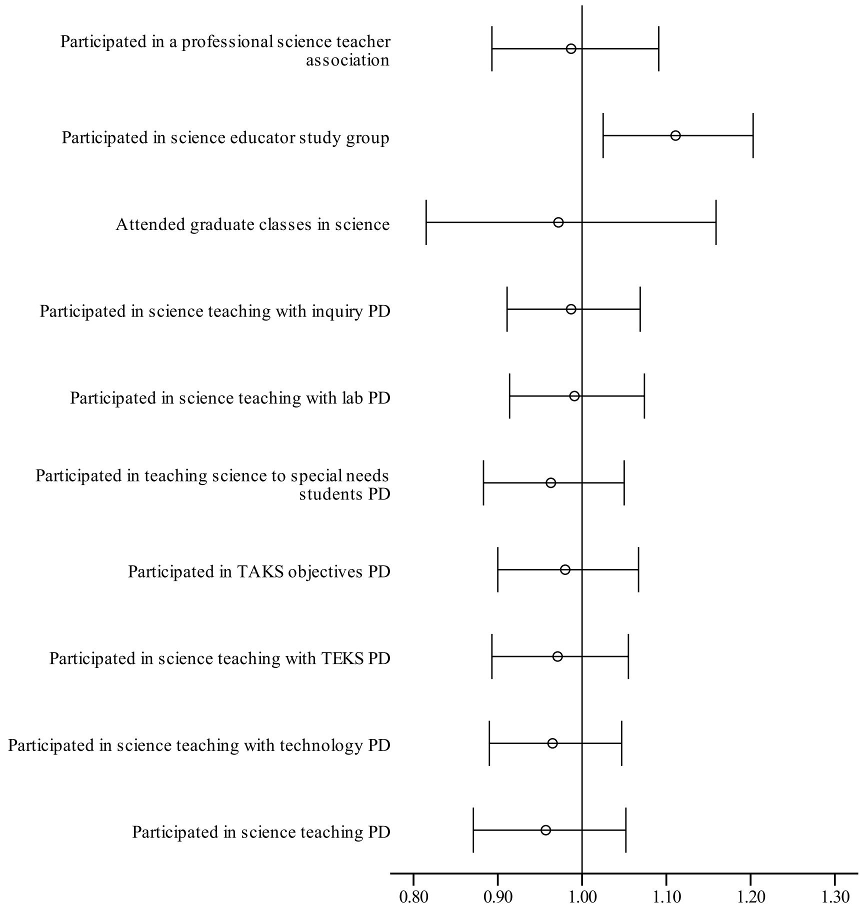

FIGURE 18. *Using the risk statistic to describe the likelihood of teachers being retained in the profession when participating in one of ten professional development activities.*

describe a similar relationship between profession retention and participation in a science educator study group as seen with school retention. However, all other values indicate a growing negative relationship between teacher participation and retention. These results show that teachers retained at their school or moving to another school are less likely to participate in development activities than their counterparts who leave the profession.

Participation in Professional Maintenance Activities and Profession Retention. Figure 19 presents the relative risk, with 95% CI, of teachers retained in the profession as a function of participation in professional maintenance activities. As with the analysis describing the relationships between teachers participating in maintenance activities and school retention, teachers participating in maintenance activities who leave their school are more likely to move to another school and not leave the profession altogether. However, only the statistic describing the relationship between mentoring science student teachers and profession retention is both positive and significant. All other statistics, with the exception of conducting teacher research in science education and observing a new teacher when teaching, show the same positive relationship between participation in maintenance activities and likelihood of staying in the profession.

Participation in Professional Management Activities and Profession Retention. Figure 20 presents the relative risk, with 95% CI, of teachers retained in the profession as a function of participation in professional management activities. The results show that teachers who leave the profession, when compared to teachers who move to another school, are less likely to participate in off campus recruitment trips, review new teacher job applications, or write science curriculum. However, these teachers are more likely to participate in policy meetings.

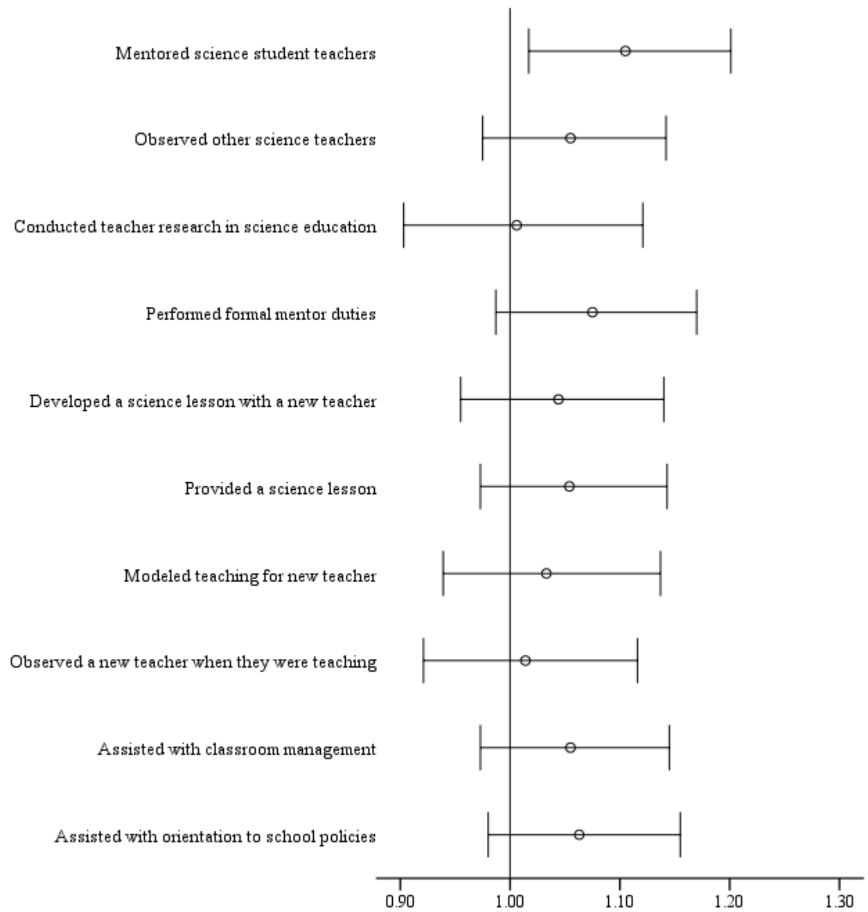

FIGURE 19. *Using the risk statistic to describe the likelihood* of *teachers being retained in the profession when participating in one of ten professional maintenance activities*.

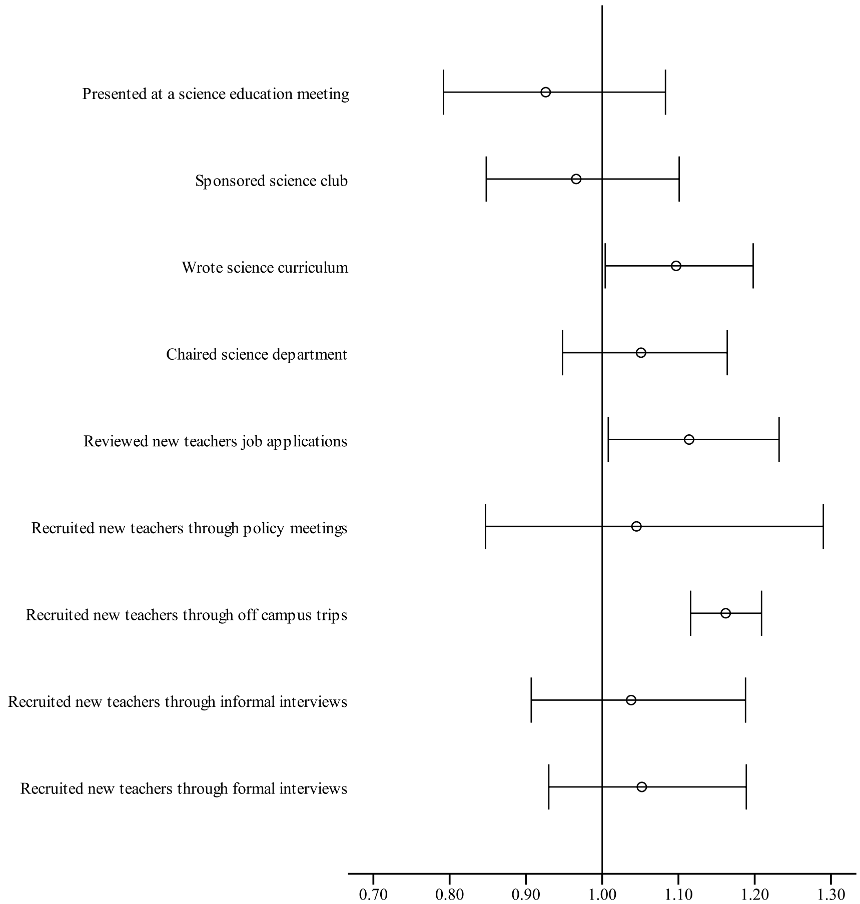

FIGURE 20. *Using the risk statistic to describe the likelihood of teachers being retained in the profession when participating in one of nine professional management activities.*

Conclusions

The PRISE dataset contains teacher response data from a multi-school cohort study of high school science teachers. Among those teachers initially surveyed, approximately three in four teachers stayed at their school one year after completion of the survey. Of the remaining teachers surveyed slightly more than half left the profession altogether while all others moved to another school. These results indicate that the high school science education population in Texas is losing teachers at a higher rate than schools who lose teachers to teach in other schools. Specifically, the 50 schools in the PRISE study lost approximately 25 percent of their teachers at the end of one academic year; however, of those teachers who left a school, more than 50 percent were lost from the profession.

Prevalence of Teacher Participation in Professional Activities

In addition to providing insight into teacher attitudes, the PRISE research group evaluated teacher participation in professional activities using a broad and comprehensive list of teacher professional activities. Frequency analyses of responses show that teachers are more active in professional development as opposed to professional maintenance or management activities. This trend holds true for all teachers regardless of mobility status (e.g., stayed at their school or stayed in the profession). Teachers were most active in development activities related to general science teaching, use of technology in the classroom, and state standards for student learning. However, teachers were least likely to attend graduate courses in science, participate in science educator groups, or conduct research in science education. The prevalence of teacher participation in professional maintenance and management activities was low regardless of teacher mobility status. These results illustrate that teachers are not as active in the maintenance and management of the science education profession as they could be.

Few prior studies have evaluated high school science teacher mobility one year after measurement of participation in professional activities. A primary goal of education stakeholders is to provide teachers with professional activity opportunities, but our understanding of the prevalence of teacher participation in professional activities has been limited. In addition, teacher mobility has been linked to teacher participation in professional activities. Accordingly, identification of professional activities associated with teacher mobility can allow stakeholders to focus on the activities most likely to reduce mobility.

Associations between Teacher Participation in Activities and Retention

Results from this study indicate no associative relationship between teacher participation in development activities related to science teaching in general, use of technology in the classroom, or state standards for student learning with teachers staying at their school. However, an associative relationship was indicated between two less prevalent professional development activities, observation of other science teachers and involvement in a science education study group. Consequently, stakeholders providing teachers with opportunities to develop through standard professional development opportunities may wish to consider providing more support for observing and interacting with other science teachers.

Teacher participation in professional maintenance activities was low in comparison to professional development activities. However, the two most prevalent professional maintenance activities, assisting with classroom management and orientation to school, were associatively related to teachers who stayed at their school. The prevalence of teacher participation in professional management activities, like maintenance activities, was low with no associative relationship to teachers who stayed at their school. These results indicate that teachers who stay at their school are more likely to be involved in professional activities focusing on development of the school professional environment (i.e., working with other science educators) and not individual activities. Consequently, these findings suggest that science education stakeholders should encourage current teachers to take a more active role in assimilating new teachers to the school environment. These activities may reduce the likelihood of current teachers leaving their school.

Similar to the associative results for teachers staying at their school, no relationship between the most prevalent professional development activities (e.g., participation in science teaching PD and science teaching with technology PD) to teachers staying in the profession was observed. However, a relationship between teacher participation in a science education study group to teachers staying in the profession was observed, similar to the relationship found with teachers staying at their school. This would indicate that teachers staying in the profession are likely to spend time with other science educators, regardless of their decision to remain in or leave a specific school environment.

Unlike the relationship between teacher participation in the most prevalent professional maintenance activities (e.g., assisting with classroom management and assisting new teachers with orientation to the school) and teachers staying at their school, no similar relationship was observed with teachers staying in the profession. A relationship between two of the least prevalent professional maintenance activities (e.g., reviewing job applications and conducting off-campus recruitment) with teachers staying in the profession was observed. Additionally, although the prevalence of teacher participation in professional management was low, teachers who developed science curriculum were more likely to remain in the profession even if they left their school. These results indicate that teachers staying in the profession are more likely to be involved in professional activities focusing on development of the science education profession (i.e., involvement with current science educators, appraising future education professionals, and developing what is taught in science classrooms). Consequently, science education stakeholders should be aware that teachers who leave their school but remain in the profession are likely to be more interested in the science education profession *in toto* and less interested in becoming a part of a specific school environment.

Limitations

This study has several potential limitations. First, some teachers responding to the TPSST survey taught in schools employing a single high school science teacher. Accordingly, bias toward teachers in schools employing only one science teacher could have led to incorrect relative risk assessments. However, these teachers made up a small percentage of the total sample and therefore their potential bias is likely negligible. Second, frequency of teacher participation in professional activities is based on teacher self-reporting, which theoretically could lead to bias in the data collection through incomplete or inaccurate participant recall. However, the use of an instrument designed by former high school science teachers, using language common to the science education profession, minimizes the impact of this potential bias. Third, teachers who left both their current school and the teaching profession one year after completion of the TPSST survey may have done so due to retirement. However, considering that the percentages of teachers leaving their current school and leaving the profession are similar in number, the author is confident this potential bias is small. Fourth, as with all observational studies, unmeasured confounding factors could account for some of the observed relationships between teacher participation in professional activities and mobility. However, a broad data collection strategy, combined with statistical modeling of candidate factors, was designed to minimize this bias. An observational study is an appropriate method for identifying associative links between teacher mobility and participation in professional activities when data is to be gathered from a large sample. The results from this study should inform hypotheses to be tested in subsequent efficacy studies (e.g., targeting factors in this study for reducing the number of teachers leaving their current school or the profession).

Summary

In summary, this study found that schools lose approximately one in four high school science teachers every year. Multiple professional activities were associated with two teacher mobility outcomes (e.g., teachers staying at their school and teachers staying in the profession). However, the professional activities teachers were most likely to participate in (e.g., teaching science PD, teaching science with technology PD, and state standards for student learning) were not associated with either teacher mobility outcome. Recognition of this fact will be important in considering future changes in the high school science profession affecting the professional activities of high school science teachers.

CHAPTER IV

JOB SATISFACTION OF HIGH SCHOOL SCIENCE TEACHERS: PREVALENCE AND ASSOCIATION WITH TEACHER RETENTION

The recruitment and retention of teachers in the United States has been the focus of school reform policy for over a quarter century (Taylor & Bogotch, 1994). School reform policies affecting science teachers have come under particular scrutiny due to the perceived crisis in the retention of these teachers within schools and/or the profession (Allensworth, Ponisciak, & Mazzeo, 2009; Ingersoll, 2001). The purpose for some of these policies is to improve the working conditions for teachers (Butt, Lance, Fielding, Gunter, Rayner, & Thomas, 2005). Research shows that teachers' attitudes regarding their schools' working conditions influences job satisfaction (Kearney, 2008). The research reported in this chapter examines science teachers' attitudes regarding school working conditions and the association of these attitudes to school and profession retention.

Each year high school administrators must identify, recruit, and employ thousands of science teachers to replace those lost due to retirement, mobility, and attrition (Ingersoll, 2001). This practice of maintaining the teacher population within individual schools, as well as within the profession, is a simple solution predicated on the assumption that a large pool of replacement teachers exist and that student enrollment numbers will remain constant in the future. However, recent research shows that the pool of replacement teachers is decreasing as "baby boomer" teachers near retirement age (Mont & Rees, 1996) while increasing student enrollment is forecasted (Feng, 2005). In response, policymakers at all organization levels (i.e., national, state, and local) have introduced reform policies designed to create better working conditions that will lead to increasing teacher retention (Feiman-Nemsar, 2001; National Commission on Teaching and America's Future [NCTAF], 1997).

Job Satisfaction and Research Questions

Definitions for job satisfaction exist in the fields of human resource management (Brief & Weiss, 2002), public policy (Quarstein, McAfee, & Glassman, 1992), medicine (Scott, Gravelle, Simeons, Bojke, & Sibbald, 2006a) and education (Hean & Garrett, 2001). Although lacking a formal definition, many researchers define job satisfaction as an affective reaction to a job (Butt et al., 2005). Weiss (2002) suggests that individuals form attitudes of satisfaction and dissatisfaction towards their job by a combination of internal cognitive processes and external actions. Spear, Gould and Lee (2000) concluded that sources of teacher satisfaction included working with students, the cerebral challenge of the profession, and a sense of classroom autonomy. Further, they described workload, pay, and professional status as sources of dissatisfaction.

Job Characteristics Model

Current estimates place the annual cost of public K-12 education in the United States at approximately $500 billion. The majority of these funds go to the support of teacher salaries, existing school maintenance, and new school construction. Extensive research examining the relationship between teacher salaries with job satisfaction and retention has yet to provide convincing results (Bishay, 1996; Butt et al., 2005; Weiqi, 2007). However, many researchers conclude that the main source of job satisfaction for teachers does not originate from salary, but from the interpersonal relationships teachers experience with other teachers, administrators, and students (Butt et al., 2005). In addition to interpersonal relationships, research findings suggest that attitudes about their schools' working conditions influence teachers' job satisfaction and commitment (Borman & Dowling, 2008; Mont & Rees, 1996; Weiss, 1999).

This chapter describes teachers' job satisfaction as a function of their attitude about their choice of profession and school working conditions. In order to place the results in context it is worth considering a common job satisfaction model currently in use by researchers, the Job Characteristics Model (JCM). Hackman and Oldham (1976) proposed the JCM as a framework for studying how particular job characteristics influence the job satisfaction of individuals (see Figure 21). The model proposes five core job characteristics (skill variety, task significance, task importance, autonomy, and feedback) influencing three psychological states (experienced meaningfulness, experienced responsibility, and knowledge of actual results), that in turn influence job satisfaction. Each of the core characteristics situates the worker in an organization composed of supervisors, co-workers, and inanimate objects required for completing tasks. For science teachers, these organizational components correlate to school administrators, fellow teachers, and classroom materials.

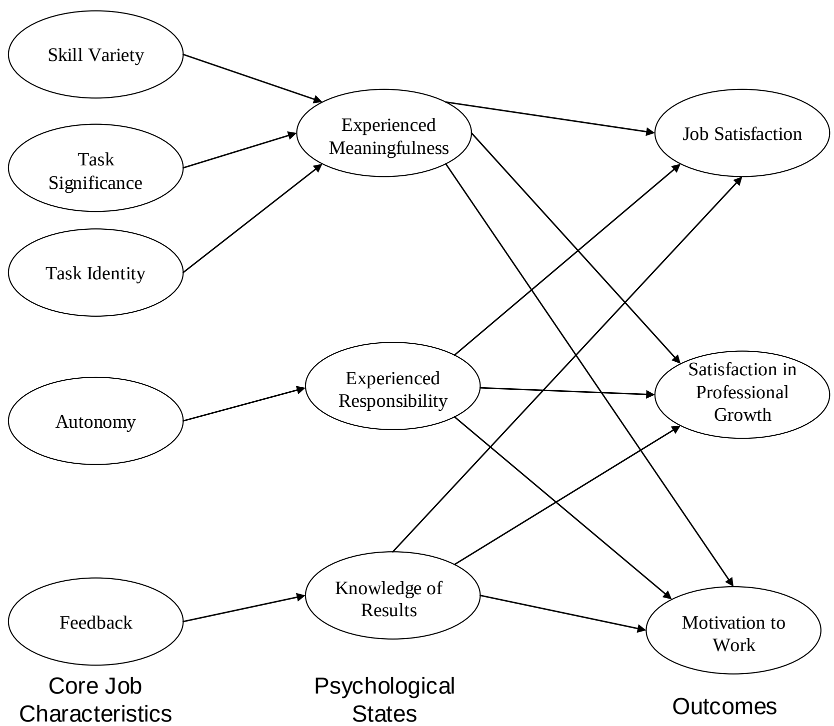

FIGURE 21. *A review of Hackman and Oldham's Job Characteristics Model.*

Research Questions

The prior chapter used a sample of 385 Texas high school science teachers to examine both the prevalence of teacher participation in each of 29 different professional activities and the associative relationship of their participation with school and professional retention. The research in this chapter used the same teacher sample in examining the extent to which teachers are satisfied with their choice of profession and school working conditions and the associative relationships with school and professional retention. In this chapter, I provide evidence to answer the following questions:

Research Question 1: What is the prevalence of teacher attitude about occupational choice and specific school working conditions?

Research Question 2: Are there differences in teacher attitudes by teacher mobility status?

Research Question 3: What are the associations between teacher attitudes and decisions to remain at their current school?

Research Question 4: What are the associations between teacher attitudes and decisions to remain within the profession?

Purpose of the Study and Method

The purpose of this study is to understand the prevalence of teacher attitudes with their choice of profession and school working conditions and the relationship between satisfaction with those conditions and retention. To assess the prevalence of high school science teacher attitude and examine the associative relationship with retention, I compiled data from the PRISE research study. The study used a probability sample of 385 teachers situated in 50 Texas high schools. Teacher data for this study is archived in the PRISE Teacher Database. I used data archived within the Job satisfaction and Retention datasets to conduct the research reported in this chapter (see Table 18).

TABLE 18
A Review of the Datasets in the PRISE Teacher Database

Dataset name	Archived data
School context	Size, minority status, region, and grades served by teacher's school
Activity	Participation status of teachers in professional activities
Job satisfaction	Satisfaction of teachers with school environment
Certification	Certification(s) possessed by teachers
Schedule	Classes taught by teachers
Teacher context	Demographic data describing teachers
Retention	Retention status of teachers

Sample

The PRISE teacher sample was selected using a multistage probability design. In the first stage of the design, Texas public high schools were stratified using two explicit variables (e.g., size and minority student enrollment proportion) and one implicit variable (e.g., geographic area within the state). This stage resulted in a sample of 50 high schools to represent the population of 1,333 Texas high schools. Administrators from each school were invited to participate in the PRISE research study through either phone contact, a face-to-face meeting at the school, or during a meeting at Texas A&M University in Fall 2007. From the original sample, 39 school administrators chose to participate. Replacement schools (n = 11) were identified and their administrators were contacted in January 2008. Each replacement school administrator agreed to participate in the study. In the second stage of the design, all teachers responsible for teaching at least one state defined high school science course within each sampled school was selected for participation.

PRISE researchers identified 385 science teachers within the 50 sampled schools. Data collection for teachers began in February 2008 and continued through May of the same year. Imputation of non-response teacher data to teacher participation questions used modal values within school for each non-responding teacher (n = 42). The final operational sample consisted of 385 teachers from 50 schools. Table 19 presents the final return rates for the teacher sample from the PRISE research study.

TABLE 19
A Review of Teacher Survey Return Rates from the PRISE Research Study

School sample status	Total teacher sample	Total surveys returned	Return rate (%)
Original (n=39)	316	280	88.6
Replacement (n=11)	69	63	91.3
Total	385	343	89.1

Measures

Teacher Attitude Regarding School Working Conditions. To measure teacher attitudes, PRISE researchers created the *Texas Poll of Secondary Science Teachers* (TPSST). The TPSST is a 20-item instrument that identifies teachers' participation in professional activities and levels of satisfaction with their schools' working conditions. The TPSST is a valid (Cronbach's alpha = 0.862) and reproducible instrument designed specifically for high school science teachers. Teachers were asked to declare their satisfaction for each of 14 school working conditions on a four-point ordinal scale. Measures of individual teacher satisfaction responses (1 = very dissatisfied, 2 = dissatisfied, 3 = satisfied, and 4 = very satisfied) are archived in the Job satisfaction dataset of the PRISE Teacher Database. For my analyses each response was recoded as Satisfied = 1 (3 or 4) or Dissatisfied = 2 (1 or 2). Table 20 provides the list of working condition questions on the TPSST.

TABLE 20
Job Satisfaction Questions from the TPSST Archived in the Job Satisfaction Dataset

Job satisfaction question	Variable name
How satisfied are you with your choice of profession?	Q7
How much do you agree with the following statement: Improving student achievement in science is a team effort at my school.	Q8
How satisfied are you with the level of collegiality and cooperation with other teachers at your school?	Q9
How satisfied are you with the contribution of your schools science program to student development?	Q10
How satisfied are you with ability make decisions regarding instructional methods?	Q11
How satisfied are you with school support for informal science activities?	Q12
How satisfied are you with science specific PD options at your school?	Q13
How satisfied are you with school support for PD?	Q14
How satisfied are you with your school’s science laboratory facilities?	Q15

TABLE 20 continued

Job satisfaction question	Variable name
How satisfied are you with your school's science laboratory equipment?	Q16
How satisfied are you with recognition from your school for your teaching efforts?	Q17
How satisfied are you with current teaching assignment?	Q18
How would you rate your personal safety at your school?	Q19
How satisfied are you with administrative communication at your school?	Q20

Teacher Retention Status. To determine the retention status of teachers, the PRISE research group used data archived by the Texas Education Agency (TEA). Specifically, the TEA archives the career trajectory of every Texas public school teacher; consequently, PRISE researchers were able to classify the retention status of each teacher identified in the PRISE teacher sample by submitting the names of each participant teacher to the TEA. Teachers were classified as (a) Stayer, if TEA identified the teacher as being at the same school during both the 2007-2008 and 2008-2009 school years; (b) Mover, if TEA identified the teacher as teaching in different Texas schools between the same two school years; and (c) Leaver, if TEA did not identify the teacher as teaching in a Texas school during the 2008-2009 school year. Retention status for each teacher is archived in the Retention dataset of the PRISE Teacher Database. Table 21 provides the distribution of 385 sampled teachers according to their retention status.

TABLE 21
A Review of the Frequency Distribution of Teachers Classified as Leaver, Mover, and Stayer (n=385)

Teacher mobility status	Frequency	Percentage (%)	Cum. Percentage (%)
Leaver	53	13.8	13.8
Mover	41	10.6	24.4
Stayer	291	75.6	100.0
Total	385	100.0	

Analytic Approach

I used two analytic approaches. First, to examine the prevalence of teacher satisfaction with their chosen profession and school working conditions, I conducted frequency analysis on teacher responses to each of the job satisfaction questions listed in Table 20. In addition, I used this approach to examine the differences in satisfaction for teachers categorized as Stayer, Mover, or Leaver. Second, to examine the associative strength of teacher satisfaction with retention, I calculated the relative risk (RR) statistic. I conducted all analyses and created all figures using SPSS statistical software, release 18.0.

Frequency Analysis. Frequency analysis is a primary analysis technique useful for identifying typical values of variables, checking assumptions for statistical tests, and determining the quality of data. I used frequency analysis to calculate the probability of teacher satisfaction for each of the variables listed in Table 20. I also used this technique to identify probability rates within different teacher retention states.

Relative Risk. The RR statistic describes the likelihood of an event occurring in the presence of a factor to the same event in the absence of that factor. For my study, I considered the retention state of a teacher, either retained at the school (Stayer vs. Mover and Leaver) or in the profession (Stayer and Mover vs. Leaver), as the event and satisfaction with occupational choice or a school working condition as a factor. Calculation of the RR statistic requires creating a 2x2 matrix to categorize each participant within one of the four matrix cells (see Figure 22). Equation 1 on the next page describes the likelihood of a teacher being retained when satisfied with occupational choice or a school condition. Equation 2 describes the 95% confidence interval (CI) for the RR statistic. If the 95% CI for the RR of a specific school condition encompassed 1.00, I assumed no significant association between teacher satisfaction and the corresponding retention state. Table 22 provides an example of the RR statistic. For this example, retained at a school is the event and satisfaction with administrative communication is the factor.

	Event		
Factor	Yes	No	Total
Yes	A	B	a + b
No	C	D	c + d
Total	a + c	b + d	a + b + c + d

FIGURE 22. *A second look at a 2x2 matrix describing how data are categorized for calculating the relative risk statistic.*

$$RR = [a / (a+b)] / [c / (c+d)] \quad (1)$$

$$95\%\ CI = \ln(RR) \pm 1.96 * S.E._{\ln(RR)} \quad (2)$$

TABLE 22
The Cross Distribution of Satisfaction with Administrative Communication by School Retention Status for 385 Texas High School Science Teachers

	Retained at a school (event)		
Satisfied with administrative communication (factor)	Yes	No	Total
Yes	236	69	305
No	55	25	80
Total	291	94	385

Results

Research Question 1: What Is the Prevalence of Teacher Attitude about Occupational Choice and Specific School Working Conditions?

Figure 23 displays the proportion of teachers (n = 385) satisfied with 14 different working conditions in their schools. The results in Figure 23 indicate that a large proportion (greater than 0.90) of teachers are satisfied with their occupational choice. This is consistent with the retention rate of more than three out of four sampled teachers at their respective schools and almost nine out of ten teachers in the profession (see Table 22). In addition, large proportions (greater than 0.80) of teachers indicate

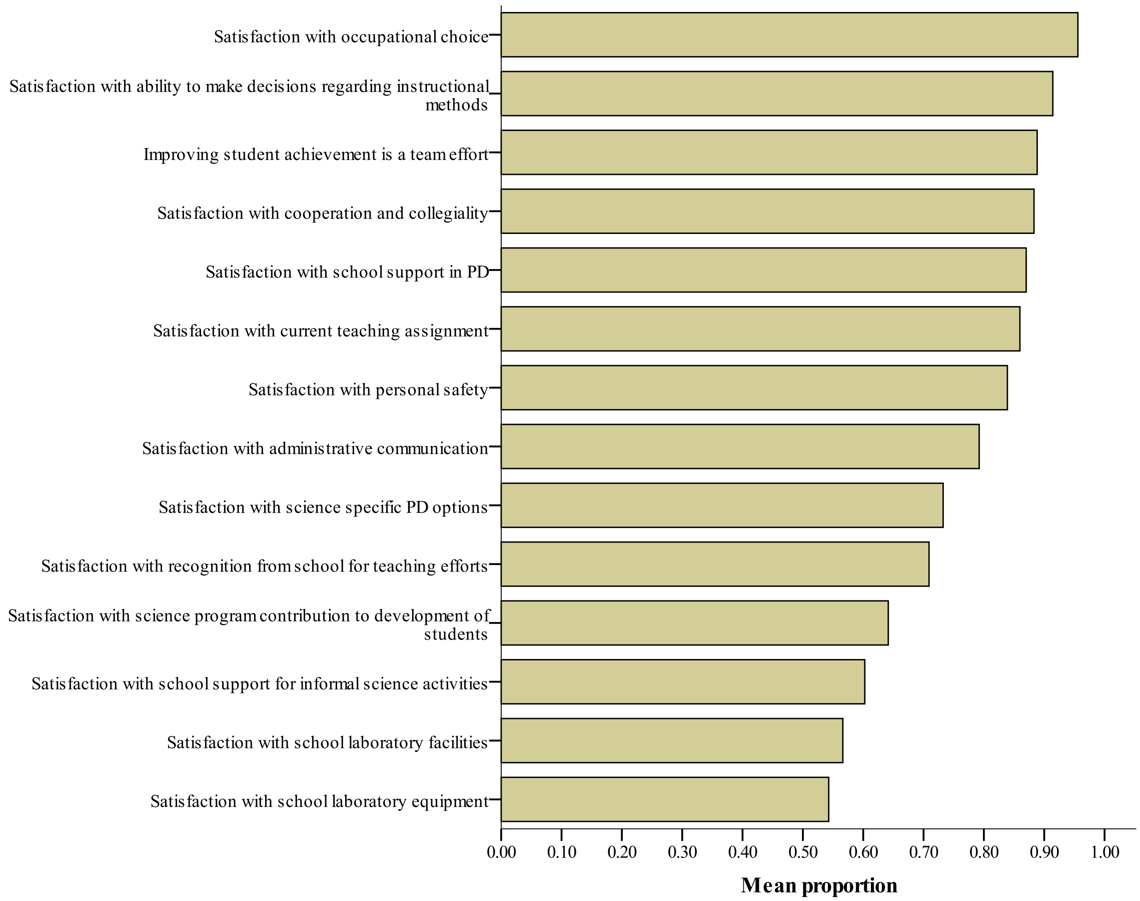

FIGURE 23. *The mean proportion of teachers (n=385) indicating some level of satisfaction with a school working condition.*

satisfaction with their fellow teachers and administrators. These results are consistent with the JCM, which contends that job satisfaction for individuals is dependent on the interpersonal relationships with co-workers and supervisors. By contrast, smaller proportions (less than 0.60) of teachers indicate satisfaction with their school's laboratory facilities and laboratory equipment or support for informal science activities. These results suggest that teachers are generally satisfied with their professional colleagues but that institutionalization of school reform policies initiated in the last quarter century to improve school working conditions has yet to occur.

Research Question 2: Are There Differences in Teacher Attitudes by Teacher Mobility Status?

Figure 24 presents the proportions of teachers, distributed across three mobility states, satisfied with 14 different working conditions in their school. The results in Figure 24 indicate that, across the three states, differences in teacher satisfaction with their schools' working conditions do occur. Leaver proportion values in Figure 24 mirrored those of Stayer more closely than Mover. Additionally, for 8 of the 14 working conditions, the proportion of Mover teachers expressing satisfaction was lower than both Stayer and Leaver. These eight conditions include: (1) improving student achievement is a team effort, (2) cooperation and collegiality, (3) school support in PD, (4) science specific PD options, (5) recognition from school for teaching efforts, (6) science program contribution to development of students, (7) school laboratory facilities, and (8) school laboratory equipment. These results suggest that teacher satisfaction with working conditions is associated with teachers' decisions to remain in their current school but not in their decisions to leave the teaching profession.

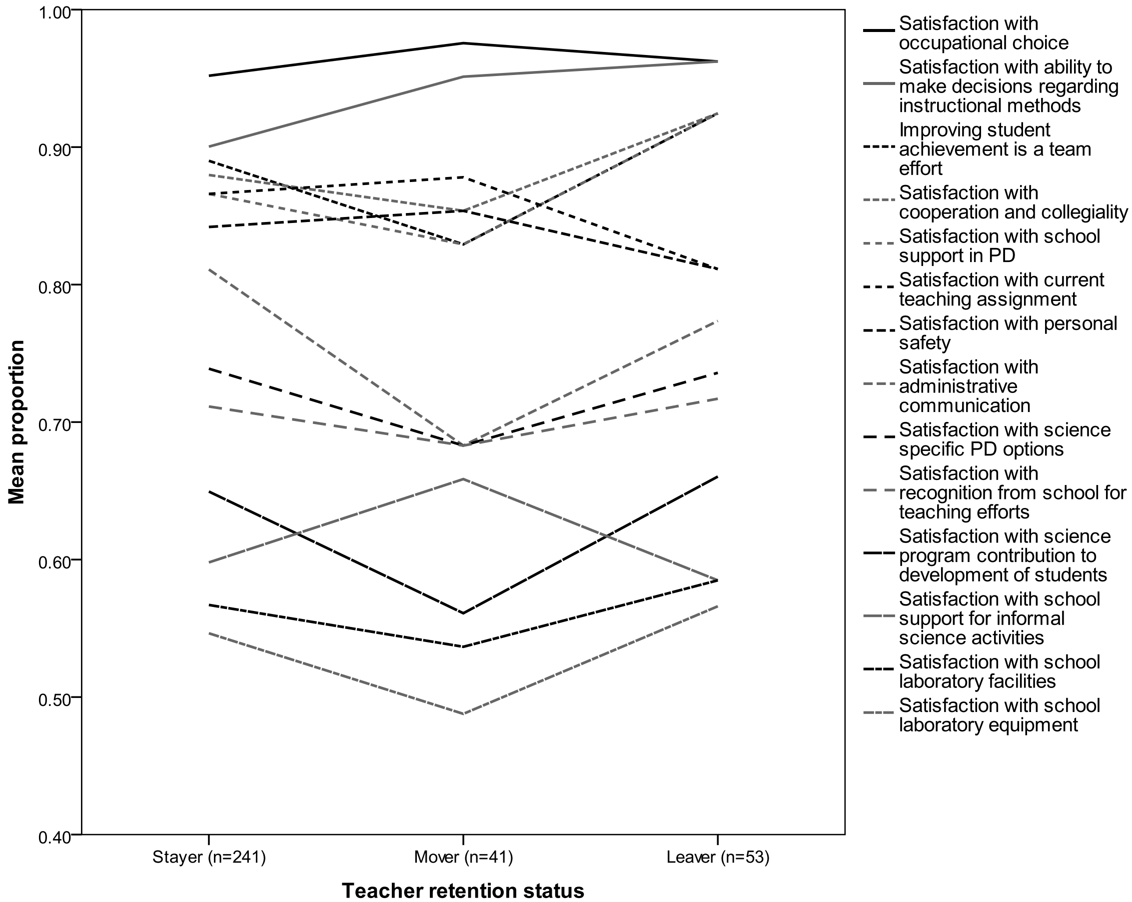

FIGURE 24. *The mean proportion of teachers, by retention status, indicating satisfaction with their schools' working conditions.*

Research Question 3: What Are the Associations between Teacher Attitudes and Decisions to Remain at Their Current School?

Figure 25 shows the RR values describing the likelihood for teachers to be retained at their school when satisfied with a working condition. The majority of the values in Figure 25 (12 out of 14) have values close to 1.00 and 95% CI encompassing 1.00. This indicates no associative relationship between the majority of working conditions and school retention. However, teachers who are satisfied with their freedom to make decisions regarding instructional methods are approximately 15% less likely to stay at their school. This suggests that teacher autonomy is not as important for all teachers as has been previously discussed in the literature. By contrast, teachers satisfied with administrative communication at their school are about 15% more likely to be retained; suggesting that teachers are most likely to be retained when satisfied with the communication between themselves and their school administrator.

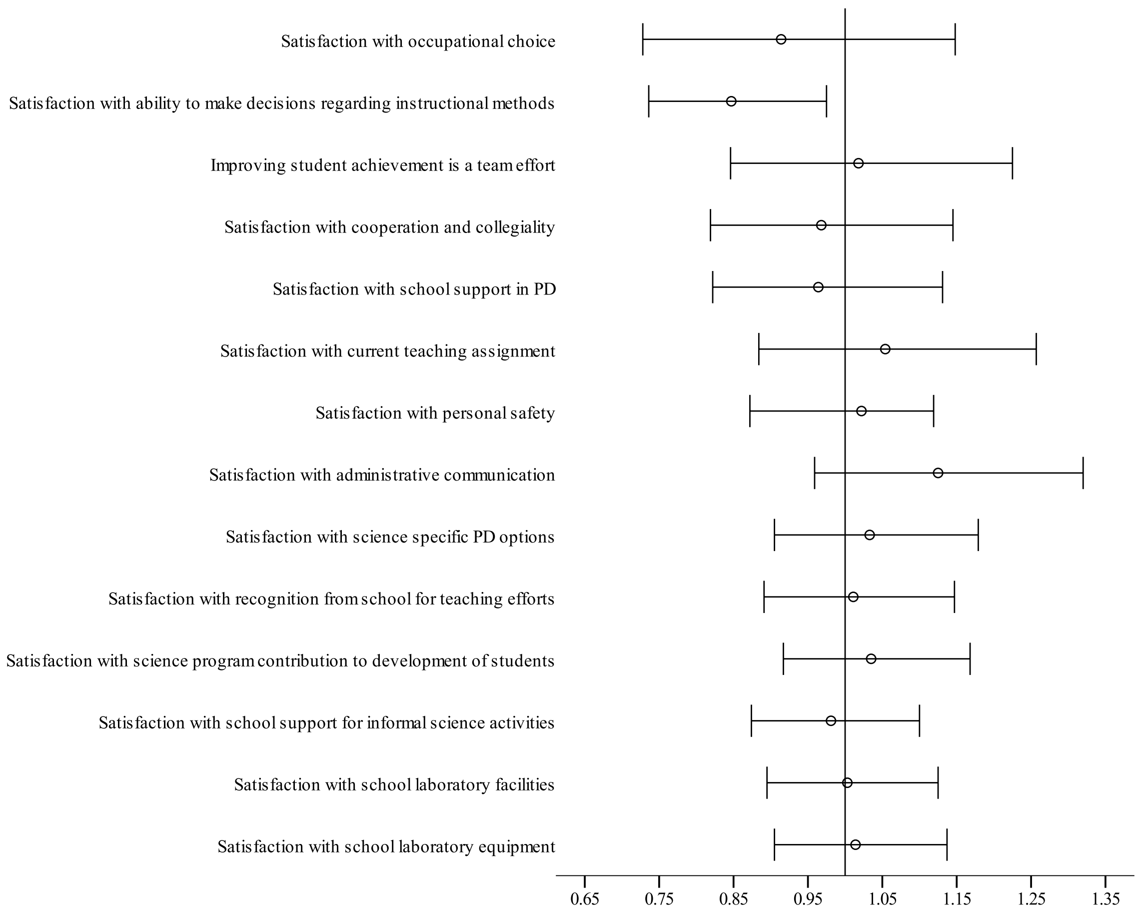

FIGURE 25. *Using the risk statistic to describe the likelihood of teachers being retained by their school when indicating satisfaction with their schools' working conditions.*

Research Question 4: What Are the Associations between Teacher Attitudes and Decisions to Remain within the Profession?

Figure 26 shows the RR values describing the likelihood of teachers being retained in the profession when satisfied with their occupational choice or school working conditions. All values showed no statistically significant associations between satisfaction and profession retention. A closer look reveals that teachers less likely to remain in the profession report higher satisfaction with their level of freedom to make decisions regarding instructional methods, that improving student achievement at their school is a team effort, cooperation and collegiality among teachers at their school and school support in PD. These results would seem counterintuitive; however, the values for 13 of the 14 working conditions, including the previously mentioned ones, show that teacher satisfaction with school working conditions is more likely to lead to teachers leaving the profession rather than leaving their school (see Figure 25). Furthermore, these results may be confounded by the effects of retirement and not early professional attrition.

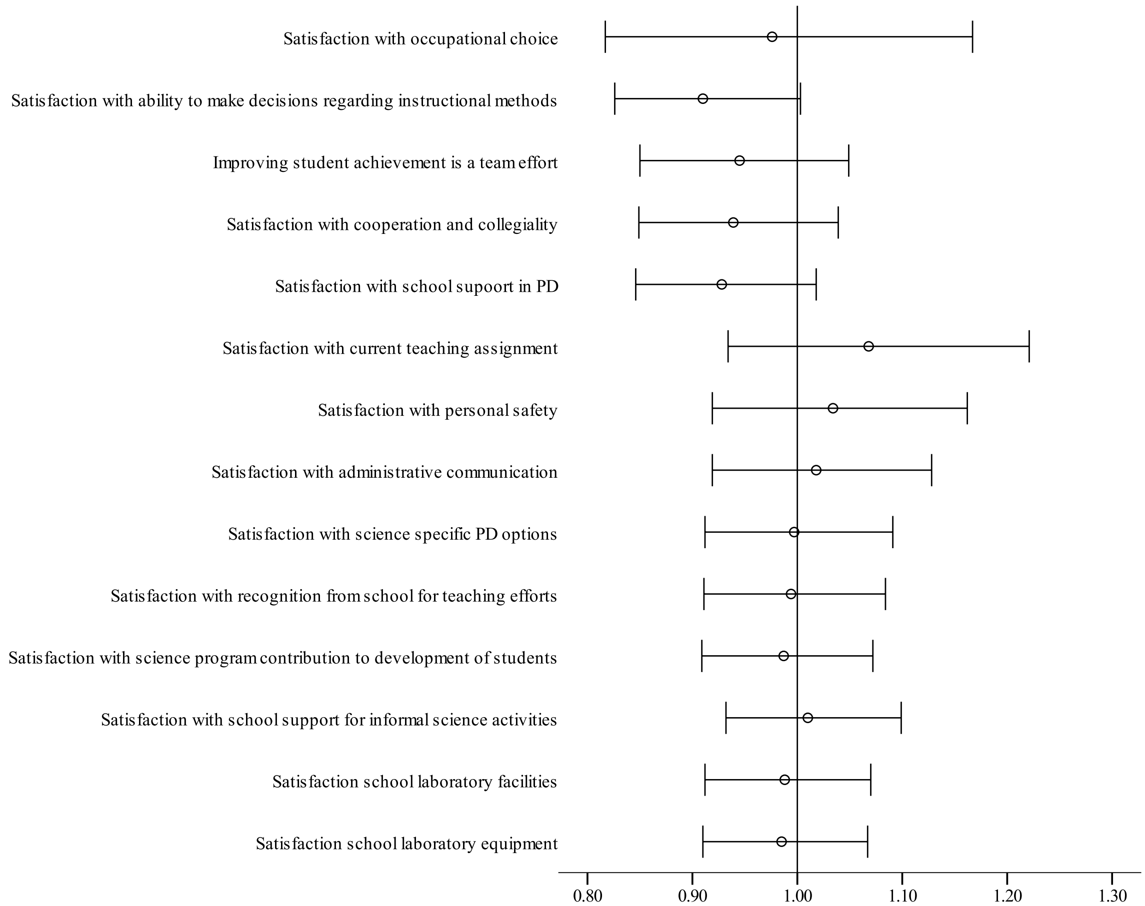

FIGURE 26. *Using the risk statistic to describe the likelihood of teachers being retained in the profession when indicating satisfaction with their schools' working conditions.*

Conclusions

An observational study is an appropriate method for describing teacher job satisfaction and examining associative relationships between teacher satisfaction and mobility. The analyses presented in this chapter increase our knowledge regarding teachers' attitudes about occupational choice and working conditions as well as the relationships between those attitudes and retention. In particular, there is credible evidence that large numbers of teachers are satisfied with their professional colleagues whereas fewer are satisfied with their schools' science teaching facilities and equipment or support for informal science activities. Additionally, teachers who stay at their school are more likely to have a favorable attitude about their school administrators than teachers who leave their school. Finally, teachers remaining in the profession, but leaving their schools, are likely to do so because of less than optimal satisfaction with their schools' working conditions.

Prevalence of Teacher Satisfaction with Occupational Choice and School Environment and Association with Retention

In addition to providing insight into teacher participation in professional activities, the PRISE research group evaluated teachers' satisfaction with their occupational choice and colleagues. Frequency analyses of teachers' responses to the TPSST suggest that teachers are most satisfied with their occupational choice, colleagues, and school characteristics related to student achievement in science. Frequency analyses also suggested categorization of teacher job satisfaction into three different groups. Group 1 consisted of satisfaction with their occupational choice and colleagues. Teachers exhibited the highest levels of satisfaction with variables in this group. Group 2 consisted of satisfaction with administrative communication, science PD options, and recognition for teaching efforts. Teachers exhibited moderate levels of satisfaction with variables in this group. Group 3 consisted of satisfaction with science program contribution to development of students, support for informal science, and science facilities and equipment.

Results from this study indicate little associative relationship between teacher satisfaction with their occupational choice and school characteristics. However, it should be noted that teacher autonomy, a factor mentioned by many researchers as an important component related to teacher job satisfaction, was not positively associated with retention.

Limitations

This study has several potential limitations. First, some teachers responding to the TPSST survey taught in schools employing a single high school science teacher. Accordingly, bias toward schools employing only one science teacher could have led to incorrect probability assessments. However, these teachers made up a small percentage of the total sample and therefore their potential bias is likely negligible. Second, teacher job satisfaction is based on self-reporting, which theoretically could lead to bias in the data collection through incomplete or inaccurate participant recall. However, the use of an instrument designed by former high school science teachers, using language common to the science education profession, minimizes the impact of this potential bias. Third, teachers who left both their current school and the teaching profession one year after completion of the TPSST survey may have done so due to retirement. However, considering that the percentages of teachers leaving their current school and leaving the profession are similar in number, the author is confident this potential bias is small. Fourth, as with all observational studies, unmeasured confounding factors could account for some of the observed relationships between teacher job satisfaction and mobility, however, a broad data collection strategy, combined with statistical modeling of candidate variables, was designed to minimize this bias.

Summary

My analyses indicate that current institutionalization of reform policy, such as national and state science standards, in schools has yet to occur. This may be a result of administrators not appreciating the potential links between teacher job satisfaction, retention, and student achievement or insufficient funds for maintaining existing schools or building new schools. Consequently, greater effort should be expended on stressing the role of working conditions on teacher retention to school administrators. In addition, minimum standards for the facilities and equipment used in teaching science should be reviewed and amended as necessary. Finally, schools and their districts should review their current policies concerning the involvement of students in informal science activities.

CHAPTER V

HIGH SCHOOL SCIENCE TEACHERS' JOB SATISFACTION AND PARTICIPATION IN PROFESSIONAL ACTIVITIES: AN ASSOCIATIVE MODEL OF ACTION AND ATTITUDE FOR RETAINED TEACHERS

The school restructuring movement of the 1980s began a stream of research (Clune & White, 1988; Darling-Hammond, 1990; Imber & Neidt, 1990) that continues today (Day, Elliot, & Kington, 2005; Day, 2008; Elfers, Plecki, & McGowan, 2007). This movement led to the creation of school reform policies designed to encourage teacher professionalization, school based management, and shared decision-making between administrators and teachers (Taylor & Bogotch, 1994). The end goal for many of these policies was the retention of skilled teachers having both professional expertise and deep knowledge of their school environment (Farber, 1991). However, as noted by Taylor and Bogotch (1994), institutionalization of these policies takes time. Additionally, evaluation of the effects of these policies on teacher retention requires concurrent study of both policies and teachers. Such an evaluation on science teacher retention is undertaken in the present study.

Since the publication of *A Nation at Risk* in 1983, most states have increased the number of science courses required for high school graduation (Smith, 2004). In addition, passage of the *No Child Left Behind Act* has increased pressure on schools to hire teachers in high school science classrooms who are "highly qualified" (Ingersoll, 2006). In response, science education researchers and practitioners have focused on programs for retaining both in-service (Eick, 2002; Feiman-Nemser, 2001; Feng, 2005; Liu & Johnson, 2006) and pre-service science teachers (Scott, Milam, Stuessy, Blount, & Bentz, 2006b). Many of these programs use activities related to professional development (i.e., strategies for using learning standards), maintenance or mentorship (i.e., mentorship of in-service and pre-service teachers) and management or leadership (i.e., participation in new teacher recruitment).

Reform Policy as a Retention Method

Feiman-Nemser (2001) argued that systematic teacher supports can effectively increase teacher retention. These supports involve relationships between teachers and other classroom teachers and their school administrators. Teacher-teacher supports mentioned in the literature include development of science-learning professional communities, teacher mentorship, and socialization outside the school environment (Borman & Dowling, 2008; Eick, 2002; Feiman-Nemser, 2001; Kardos, Johnson, Peske, Kauffman, & Liu, 2001). Teacher-administration supports include improvement of working conditions, increased salaries and autonomy, reduced class sizes, and inclusion in school decision-making (Borman & Dowling, 2008; Feng, 2005; Macdonald, 1999; Murnane, Singer, & Willettt, 1989; Taylor & Bogotch, 1994).

Retaining high school science teachers is a complex policy issue influenced by multiple organizational (i.e., schools, universities, and state or national policymaking organizations) and individual (i.e., current teachers, candidate teachers and school administrators) level variables. For example, schools operating in heavily populated urban centers, as opposed to those in rural areas, have a larger potential pool of candidates from which to recruit replacement teachers. However, these schools must compete with the other school districts and professions located in large urban centers. Additionally, teachers possessing educational backgrounds in the sciences have historically enjoyed professional options outside high school classrooms. These options generally provide teachers with higher wages and/or greater societal prestige.

It is not likely that researchers will ever identify and measure all causal variables affecting science teacher retention. However, Figure 27 presents a model of teacher mobility from which it is possible to describe associative relationships between school organization and teacher level variables. In this chapter I study the relationship between a teacher characteristic and need for science teachers who are retained. Specifically, the characteristic is satisfaction with their occupational choice and the need is increasing professionalization.

Job Satisfaction

Definitions for job satisfaction exist in the fields of human resource management (Brief & Weiss, 2002), public policy (Quarstein, McAfee, & Glassman, 1992), medicine (Scott, Gravelle, Simeons, Bojke, & Sibbald, 2006a) and education (Hean & Garrett, 2001). Although lacking a formal definition, many researchers define job satisfaction as an affective reaction to a job (Butt, Lance, Fielding, Gunter, Rayner, & Thomas, 2005). Weiss (2002) suggests that individuals form attitudes of satisfaction and dissatisfaction towards their job by a combination of internal cognitive processes and external actions. Spear et al. (2000) concluded that sources of teacher satisfaction included working with students, the cerebral challenge of the profession, and a sense of classroom autonomy.

Further, they described workload, pay, and professional status as sources of dissatisfaction.

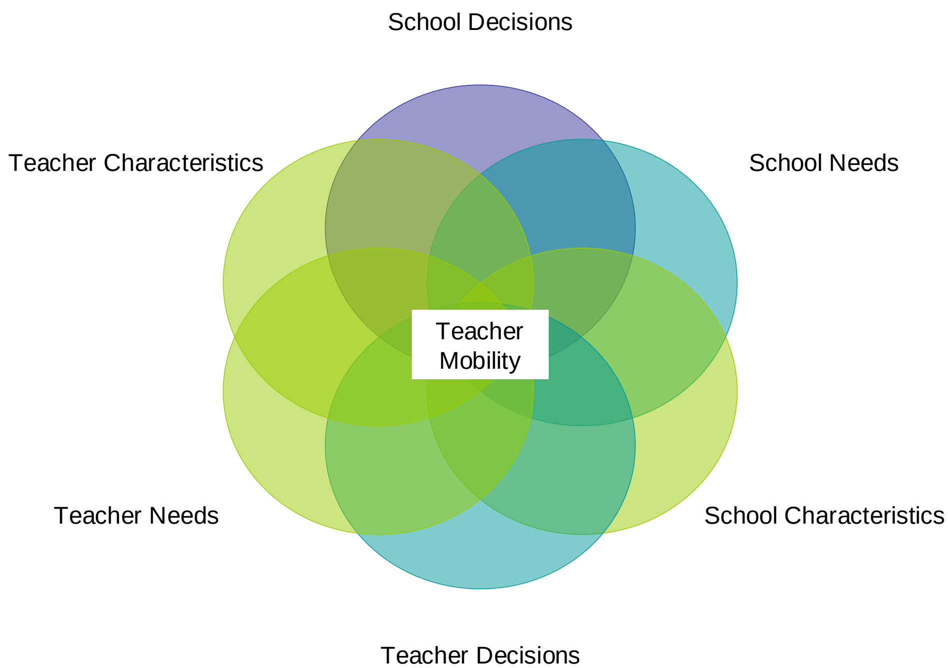

FIGURE 27. *A second look at an associative model describing teacher mobility.*

Job Characteristics Model

Current estimates place the annual cost of public K-12 education in the United States (U.S.) at approximately $500 billion. The majority of these funds go to the support of teacher salaries, existing school maintenance, and new school construction. Extensive research examining the relationship between teacher salaries with job satisfaction and retention has yet to provide convincing results (Bishay, 1996; Butt et al., 2005; Weiqi, 2007). However, many researchers conclude that the main source of job satisfaction for teachers does not originate from salary; but from the interpersonal relationships teachers experience with other teachers, administrators, and students (Butt et al., 2005). Additionally, research findings indicate that attitudes about their schools' working conditions influence teachers' job satisfaction and level of commitment (Borman & Dowling, 2008; Mont & Rees, 1996; Weiss, 1999).

This chapter describes teachers' job satisfaction as a function of their attitude about school working conditions. In order to place the results in context it is worth considering a common job satisfaction model currently in use by researchers, the Job Characteristics Model (JCM). Hackman and Oldham (1976) proposed the JCM as a framework for studying how particular job characteristics influence the job satisfaction of individuals (see Figure 28). The model proposes five core job characteristics (skill variety, task significance, task importance, autonomy, and feedback) influencing three psychological states (experienced meaningfulness, experienced responsibility, and knowledge of actual results), that in turn influence job satisfaction. Each of the core characteristics situates the worker in an organization composed of supervisors, co-workers, and inanimate objects required for completing tasks. For science teachers, these organizational components correlate to school administrators, fellow teachers, and classroom materials.

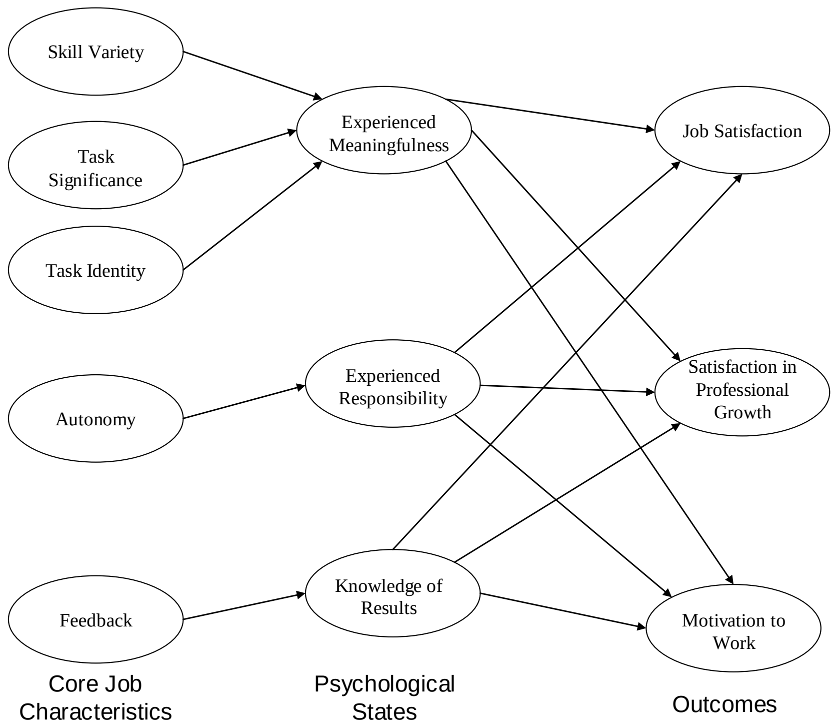

FIGURE 28. *A final review of Hackman and Oldham's Job Characteristics Model*.

Professional Activities and Research Questions

As part of the standards-based policy movement in the last century, many U.S. states made policies effecting teacher professionalization. For example, prior to 1999, the state of Texas awarded teachers a lifetime teaching certificate after passing state certificate examinations. However, on September 1, 1999 Texas legislators replaced the Lifetime Provisional certificate with the five-year Standard certificate. The new certificate requires all Texas classroom teachers to complete at least 150 continuing professional education (CPE) hours during each five-year renewal period. Types of CPE activities considered acceptable include:

1. participating in institutes, workshops, conferences, or staff development;
2. completing graduate coursework;
3. developing curriculum;
4. teaching a CPE; and/or
5. providing professional guidance as a mentor.

The existing empirical studies of teacher participation in the professional activities listed above are limited in scope. These studies generally focus on describing the activities themselves (Penuel, Fishman, Yamaguchi, & Gallagher, 2007) or the net effect on student achievement (Okoye, Momoh, Aigbomian, & Okecha, 2008; Spybrook & Raudenbush, 2009). Consequently, in the current policy environment our knowledge about the prevalence of teacher participation in specific activities is limited.

Categorizing Professional Activities

Although similar across professions, professional activities are modified according to the specifications of the individual profession (Okoye et al., 2008; Penuel, Fishman, Yamaguchi, & Gallagher, 2007) and the needs of its members (Day, 2008; Huang & Fraser, 2009). The NCLB describes effective teacher professional activities as advancing teachers' understanding of effective teaching strategies discovered through scientific research on teacher-classroom environments. Day (2008) categorized professional activities to include three major distinctions: development (Garet, Porter, Desimone, Birman, & Yoon, 2001; Moskvina, 2006), maintenance (Koballa, Bradbury, Glynn, & Deaton, 2008; Penlington, 2007), and management (McDonald, 2008). Table 23 presents categories of professional activities described by Day (2008).

TABLE 23
A Final Review of Three Professional Activity Categories Modified for the Education Profession

Professional activity[1]	Comparative term in education profession	Teacher need	Examples
Development	Professional development	Develop both content and pedagogy knowledge	One day workshops, Summer institutes, and Graduate programs
Maintenance	Mentorship	Maintain or improve standards of teaching practice	Teacher dialogue and Peer teaching
Management	Leadership	Manage both classroom and general aspects of the profession	Department head and Curriculum writer

[1]Categories described by Day (2008).

Professional Development. Professional development activities provide teachers opportunities to increase expertise in the profession (Day, 2008; Okoye et al., 2008). In their discussion of professional development activities, Desimone et al. (2002) hypothesized that six key features of development activities could be effective in improving teacher practice. The first three features are related to structure – is the activity structured to increase opportunities for reform, such as a study group, or is it a traditional workshop; what is the duration of the activity, including contact hours for the teacher; and does the activity emphasize the participation of teachers from the same school, content area, and/or grade level or is the activity for individual teachers from indiscriminate schools. Desimone et al. (2002) describes the remaining three features of professional development activities as "core" features. These features reflect substance –

is the participant engaged in a significant analysis of their teaching and potential role in student learning; is the activity consistent with teacher goals and current standards; and is increasing teacher content knowledge an end goal for teacher participation.

Professional Maintenance. Professional maintenance activities provide teachers opportunities to either maintain or improve current standards of teaching within a school or the profession (Gold, 1996). Correnti (2007) notes that many policies implemented during the standards-based era were failed attempts to improve student learning by improving standards of teaching practice in individual schools. The failure of past policies to improve teaching practice within schools, according to Correnti, was a result of limited resources available for teacher learning. However, some researchers have asserted that activities designed to maintain or improve standards of teaching practice have less to do with availability of conventional resources such as money, facilities, or experienced faculty and more to do with how resources are coordinated among teachers to improve standards of practice (Cohen, Raudenbush, & Ball, 2003). Although professional development activities focus on the individual teachers' growth as a professional, professional maintenance activities focus on the relationships experienced by teachers within the individual school or the professional community (Correnti, 2007).

Professional Management. Professional management activities provide teachers opportunities to develop leadership within the classroom, a school and/or the profession (Penlington, 2007). McDonald (2008) asserts that effective teacher leadership in the classroom requires a teacher to engage students; demand evidence-based explanations from students; and develop conceptual understanding with students. These requirements of effective classroom leadership describe professional management activities (Day, 2008; Moskvina, 2006; Penlington, 2007). Management is a function typically completed by a school administrator; however, this hierarchical relationship between administrator and teacher is a result of the importation of the factory model of the industrial age (Goldstein, 2004). As a result, many teachers today have developed a view of professional management between teachers as intrusive (Feiman-Nemser & Floden, 1986). Where professional development activities focus on the individual teacher and maintenance activities on relationships, professional management activities focus on leadership in the classroom, school or profession.

Research Questions

Each of the preceding chapters used an original sample of 385 Texas high school science teachers to examine participation rates in professional activities and satisfaction levels with working conditions. The research in this chapter uses a subsample (n = 291) of the original sample. The subsample of teachers examined in this chapter was selected because each teacher was classified as a retained teacher. This chapter provides evidence to answer the following questions:

Research Question 1: What is the prevalence of participation in professional activities by retained science teachers?

Research Question 2: Are there differences in teachers' participation rates across measures of satisfaction with occupational choice?

Research Question 3: What are retained science teachers associations between teacher satisfaction with occupational choice and participation in professional activities?

Purpose of the Study and Method

The purpose of this study is to understand the prevalence of retained teacher participation in professional activities and the associative relationship to satisfaction with occupational choice. To assess the prevalence of high school science teacher participation in professional activities, I compiled data from the PRISE research study. My study uses a subsample of 291 teachers, from the original probability sample of 385 teachers situated in 50 Texas high schools. This subsample contains all teachers retained at their schools. Teacher data for this study is archived in the PRISE Teacher Database. I used data archived within the Activity, Job satisfaction and Retention datasets to conduct the research reported in this chapter (see Table 24).

Sample

The PRISE teacher sample (n = 385) was selected using a multistage probability design. In the first stage of the design, Texas high schools were stratified using two explicit variables (e.g., size and minority student enrollment proportion) and one implicit variable (e.g., geographic area within the state). This stage resulted in a sample of 50 high schools to represent the population of 1,333 Texas high schools. Administrators from each school were invited to participate in the PRISE research study through either phone contact, face-to-face meetings at their schools, or during a meeting at Texas A&M University in Fall 2007. From the original sample, 39 school administrators chose to participate. Replacement schools (n = 11) were identified and administrators from these schools were contacted in January 2008. Each replacement school administrator agreed to participate in the study. In the second stage, all teachers responsible for teaching at least one state defined high school science course within each sampled school was selected for participation.

TABLE 24
A Final Review of the Datasets in the PRISE Teacher Database

Dataset name	Archived data
School context	Size, minority status, region, and grades served by teacher's school
Activity	Participation status of teachers in professional activities
Job satisfaction	Satisfaction of teachers with school environment
Certification	Certification(s) possessed by teachers
Schedule	Classes taught by teachers
Teacher context	Demographic data describing teachers
Retention	Retention status of teachers

PRISE researchers identified 385 science teachers within the 50 sampled schools. Data collection for teachers began in February 2008 and continued through May of the same year. Imputation of non-response teacher data to teacher participation questions used modal values within school for each non-responding teacher (n = 42). The final operational PRISE sample consisted of 385 teachers from 50 schools. For my study I selected only the 291 teachers retained by their schools. Table 25 presents the final return rates for the teacher sample from the PRISE research study.

TABLE 25
A Final Review of the Teacher Survey Return Rates from the PRISE Research Study

School sample status	Total teacher sample	Total surveys returned	Return rate (%)
Original (n=39)	316	280	88.6
Replacement (n=11)	69	63	91.3
Total	385	343	89.1

Measures

Teacher Participation in Professional Activities and Satisfaction with Occupational Choice. To measure teacher participation in professional activities and satisfaction with occupational choice, PRISE researchers created the *Texas Poll of Secondary Science Teachers* (TPSST). The TPSST is a 20-item instrument that identifies teachers' participation in professional activities and levels of satisfaction with their schools' working conditions. The TPSST is a valid (Cronbach's alpha = 0.862) and reproducible instrument designed specifically for high school science teachers. The first five questions of the instrument asks teachers to declare their participation status in (a) new teacher recruitment, (b) new teacher induction, (c) leadership, (d) science-specific professional development, (e) science professional, and (f) general (non-science) professional activities (see Table 26). Responses were coded as 1 = yes and 0 = no in the

Activity dataset of the PRISE Teacher Database. For my analyses yes was re-coded as 0 and no as 1. The last 14 questions of the instrument asked teachers to declare their satisfaction for each of 14 school attributes on a four-point ordinal scale. Measures of individual teacher satisfaction responses (1 = very dissatisfied, 2 = dissatisfied, 3 = satisfied, and 4 = very satisfied) are archived in the Job satisfaction dataset. For my analyses I only used teachers' responses to question 7, "Overall, how satisfied are you with your decision to become a high school science teacher?" Each response was recoded as Satisfied = 1 (3 or 4) or Dissatisfied = 2 (1 or 2). Recoding of data was done to facilitate computation of proportional means and the use of relative risk analysis.

TABLE 26

A Review of the Classification of Teacher Professional Activities Used in Analysis

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
New teacher recruitment	Q1A	Conducted formal interviews at the school	Management	Yes
	Q1B	Participated in informal visits with perspective teachers	Management	Yes
	Q1C	Went on recruitment trips outside school	Management	Yes
	Q1D	Attended policy meetings specific to science	Management	Yes
	Q1E	Reviewed job applications	Management	Yes

TABLE 26 continued

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
New teacher induction	Q2A	Assisted with orientation to school policies	Maintenance	Yes
	Q2B	Assisted with classroom management	Maintenance	Yes
	Q2C	Observed a new science teacher teaching a science class	Maintenance	Yes
	Q2D	Modeled teaching for a new teacher	Maintenance	Yes
	Q2E	Provided a new science teacher with a science lesson	Maintenance	Yes
	Q2F	Developed a science lesson with a new science teacher	Maintenance	Yes
	Q2G	Performed formal mentoring duties with a new science teachers	Maintenance	Yes
Leadership	Q3A	Chaired a science department	Management	Yes
	Q3B	Wrote science curriculum	Management	Yes
	Q3C	Sponsored a science club or organization	Management	Yes

TABLE 26 continued

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
Leadership	Q3D	Mentored a science teacher	Management	No
	Q3E	Joined or is a member of science teacher professional organization	Management	No
	Q3F	Presented at a science workshop, conference, or training session	Management	Yes
	Q3G	Mentored a non-science teacher	Management	No
	Q2F	Developed a science lesson with a new science teacher	Maintenance	Yes
	Q2G	Performed formal mentoring duties with a new science teachers	Maintenance	Yes
Professional development	Q3A	Chaired a science department	Management	Yes
	Q3B	Wrote science curriculum	Management	Yes
	Q4C	Participated in strategies for teaching science using the Texas Essential Knowledge and Skills (State standards) PD	Development	Yes

TABLE 26 continued

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
Professional development	Q4D	Participated in strategies for teaching students to take state exit exams PD	Development	Yes
	Q4E	Participated in strategies for teaching students with special needs PD	Development	Yes
	Q4F	Participated in strategies for teaching using laboratory PD	Development	Yes
	Q4G	Participated in strategies for teaching science using inquiry PD	Development	Yes
Science professional	Q5AA	Conducted teacher research on innovative practice in science	Maintenance	Yes
	Q5AB	Conducted peer observation with other science teachers	Maintenance	Yes
	Q5AC	Attended graduate studies in science related field	Development	Yes
	Q5AD	Participated in a science educator study group	Development	Yes

TABLE 26 continued

PRISE defined professional activity	Variable name in Teacher Database	Activity	Activity classification	Used in analysis
Science professional	Q5AE	Participated in science teaching professional association	Development	Yes
	Q5AG	Mentored student teachers preparing to become science teachers	Maintenance	Yes
General professional	Q5BA	Conducted teacher research on innovative practice in content area other than science	Maintenance	No
	Q5BB	Conducted peer observation with other teachers who did not teach science	Maintenance	No
	Q5BC	Attended graduate studies in an academic field not related to science	Development	No
	Q5BD	Participated in an educator study group not focused on science	Development	No
	Q5BE	Participated in teaching professional association that is not science specific	Development	No
	Q5BF	Wrote curriculum in a content area other than science	Maintenance	No

Teacher Retention Status. To determine the retention status of teachers, the PRISE research group used data archived by the Texas Education Agency (TEA). Specifically, the TEA archives the career trajectory of every Texas public school teacher; consequently, PRISE researchers were able to classify the retention status of each teacher identified in the PRISE teacher sample. This was done by submitting the names of each identified science teacher to the TEA. Teachers were classified as (a) Stayer, if TEA identified the teacher as being at the same school during both the 2007-2008 and 2008-2009 school years, (b) Mover, if TEA identified the teacher as teaching in two different Texas schools between the same two school years, and (c) Leaver, if TEA did not identify the teacher as teaching in any Texas school during the 2008-2009 school year. Retention status for each teacher is archived in the Retention dataset of the PRISE Teacher Database. For my analyses I only used the 291 teachers classified as Stayer in Table 27.

TABLE 27
A Final Review of the Frequency Distribution of Teachers Classified as Leaver, Mover, and Stayer (n=385)

Teacher mobility status	Frequency	Percentage (%)	Cum. Percentage (%)
Leaver	53	13.8	13.8
Mover	41	10.6	24.4
Stayer	291	75.6	100.0
Total	385	100.0	

Analytic Approach

I used two analytic approaches. First, to examine the prevalence of retained teacher participation in professional activities, I conducted frequency analysis on teacher responses for each of the professional activities selected in Table 26. In addition, I used this approach to examine the differences in participation rates for teachers categorized as Satisfied and Dissatisfied with their occupational choice. Second, to examine the associative strength of teacher participation with satisfaction, I calculated the relative risk (RR) statistic. I conducted all analyses and created all figures using SPSS statistical software, release 18.0.

Frequency Analysis. Frequency analysis is a primary analysis technique useful for identifying typical values of variables, checking assumptions for statistical tests, and determining the quality of data. I used frequency analysis to calculate the probability of retained teacher participation in professional activities listed in Table 26. I also used this technique to identify probability rates for teachers that are satisfied or dissatisfied with their occupational choice.

Relative Risk. The relative risk (RR) statistic describes the likelihood of an event occurring in the presence of a factor to the same event in the absence of that factor. I considered the satisfied state of teachers, either satisfied or dissatisfied with their occupational choice, as the event and participation in a professional activity as a factor. Calculation of the RR statistic requires creating a 2x2 matrix to categorize each study subject within one of the four matrix cells (see Figure 29). Equation 1 below describes the likelihood of a teacher being satisfied when participating in a professional activity.

Equation 2 below describes the 95% confidence interval CI) for the RR statistic. If the 95% CI for the RR of a specific school condition encompassed 1.00, I assumed no significant association between teacher satisfaction and the corresponding professional activity. Table 28 shows, in a 2x2 matrix, data describing the satisfied with occupational choice (i.e., event) and participated in science educator study group (i.e., factor) for each of the 291 teachers under study.

	Event		
Factor	Yes	No	Total
Yes	A	B	a + b
No	C	D	c + d
Total	a + c	b + d	a + b + c + d

FIGURE 29. *A final review of a 2x2 matrix describing how data are categorized for calculating the relative risk statistic.*

$$RR = [a / (a+b)] / [c / (c+d)] \quad (1)$$

$$95\%\ CI = \ln(RR) \pm 1.96 * S.E._{\ln(RR)} \quad (2)$$

TABLE 28
The Cross Distribution of Satisfied with Occupational Choice and Participated in Science Educator Study Group for 291 Texas High School Science Teachers

	Satisfied with their occupational choice (event)		
Participated in science educator study group (factor)	Yes	No	Total
Yes	46	0	46
No	231	14	245
Total	277	14	291

Results

Research Question 1: What Is the Prevalence of Participation in Professional Activities by Retained Science Teachers?

The proportions describing retained teacher participation in professional activities are presented in Figure 30. The panel's top third presents proportion values for teacher participation in professional management activities, the middle third presents proportions for professional maintenance activities, and the bottom third presents proportions for professional development activities. For teacher participation in professional development activities, the mean proportions ranged from less than 0.10 to approximately 0.90. In addition, similar participation proportions within each of three groups emerged. Group 1 consisted of science teaching, science teaching with technology, science teaching with TEKS and TAKS objectives. These activities represent those development activities in which teachers were most likely to participate, with mean proportion values ranging from 0.66 to 0.90. Group 2 consisted of teaching science to special needs students, science teaching with lab, and science teaching with Inquiry. The mean proportion values for teacher participation in these activities ranged from 0.33 to 0.50. Finally, Group 3 consisted of graduate classes in science, science educator study group, and professional science teacher association. Teachers were least likely to participate in these activities. The mean proportion values for teacher participation in these activities ranged from less than 0.10 to 0.20. For maintenance activities, the proportions ranged from less than 0.20 to approximately 0.40. For management activities, the proportions ranged from less than 0.10 to approximately 0.20. The results presented in Figure 30 indicate that retained teachers, on average, are most likely to participate in professional development activities, less likely to participate in maintenance activities, and least likely to participate in management activities.

Research Question 2: Are There Differences in Teacher Participation Rates across Measures of Satisfaction with Occupational Choice?

Satisfaction with occupational choice describes a teacher attitude or characteristic (see Figure 31). The majority of retained teachers (277 out of 299; see Table 27) used in the following analyses expressed satisfaction with their occupational choice. This suggests that this attitude and teacher mobility may be influenced by another factor such as participation in professional activities. The analyses for question 2 present a framework for describing the associative relationships used to answer question 3.

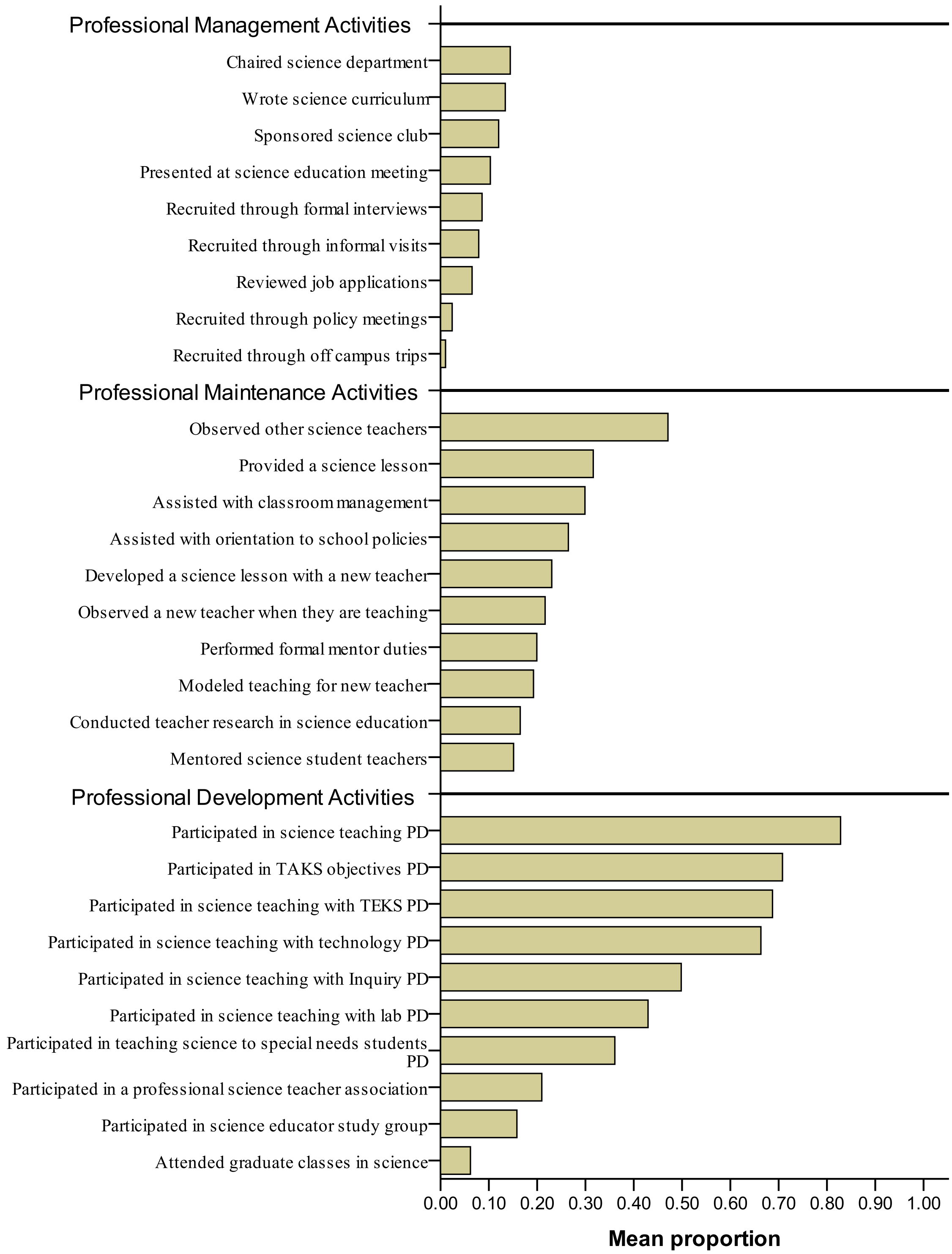

FIGURE 30. *The mean proportion of retained teachers (n=291) participating in each of 29 professional activities. Each professional activity has been categorized as development, maintenance, or management.*

The mean proportion of teachers' participating in professional development activities by satisfaction with occupational choice status are presented in Figure 31. The results illustrate the three groups described previously, with two exceptions. First, the mean proportion of teacher participation in science teaching with technology PD for teachers satisfied with their occupational choice reflects the value in Figure 31, approximately 0.75. However, the mean proportion value describing the same activity for teachers dissatisfied is less than 0.50. Second, the mean proportion of teacher participation in science teaching with Inquiry PD for teachers satisfied with their occupational choice reflects the value in Figure 31, approximately 0.50. The value describing the same activity for teachers dissatisfied with their occupational choice is approximately 0.66.

These results suggest that retained teachers who are satisfied with their occupational choice are more likely to participate in technology PD and less likely to participate in Inquiry PD than their counterparts who are dissatisfied with their occupational choice. All other results suggest retained teachers expressing satisfaction with their occupational choice are as likely to participate in professional development activities at a rate similar to teachers not satisfied with their choice. This result would suggest that no or very little interaction exists between teacher decisions regarding participation in professional development activities, attitudes concerning occupational choice, and considerations about staying at their school.

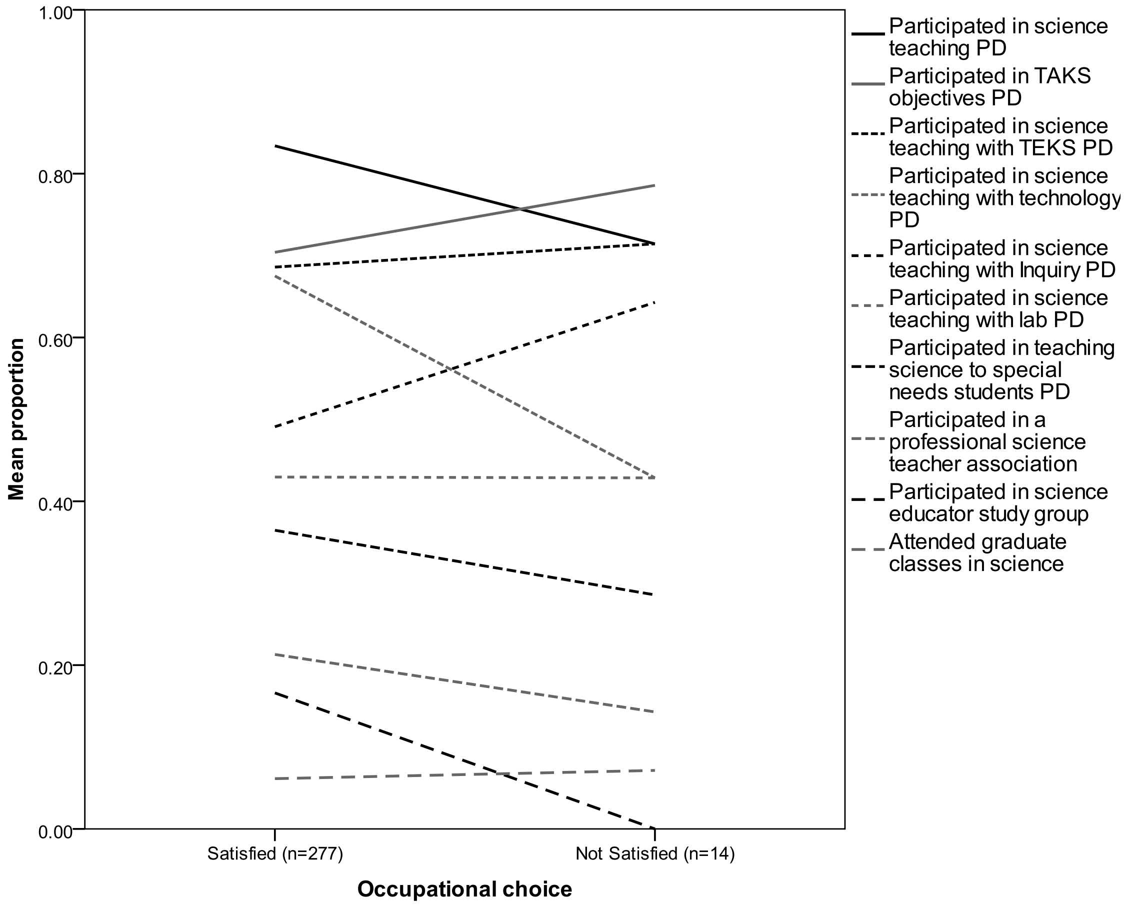

FIGURE 31. *The mean proportion of teachers, by satisfaction with occupational choice, participating in one of ten professional development activities.*

The mean proportion of teachers' participating in professional maintenance activities by satisfaction with occupational choice status are presented in Figure 32. The figure illustrates that retained teachers who are satisfied with their occupational choice participate in maintenance activities at a higher rate than teachers not satisfied with their occupational choice. These results demonstrate the interaction between teachers' decisions regarding participation in professional maintenance activities, attitudes concerning occupational choice, and considerations about staying at their school.

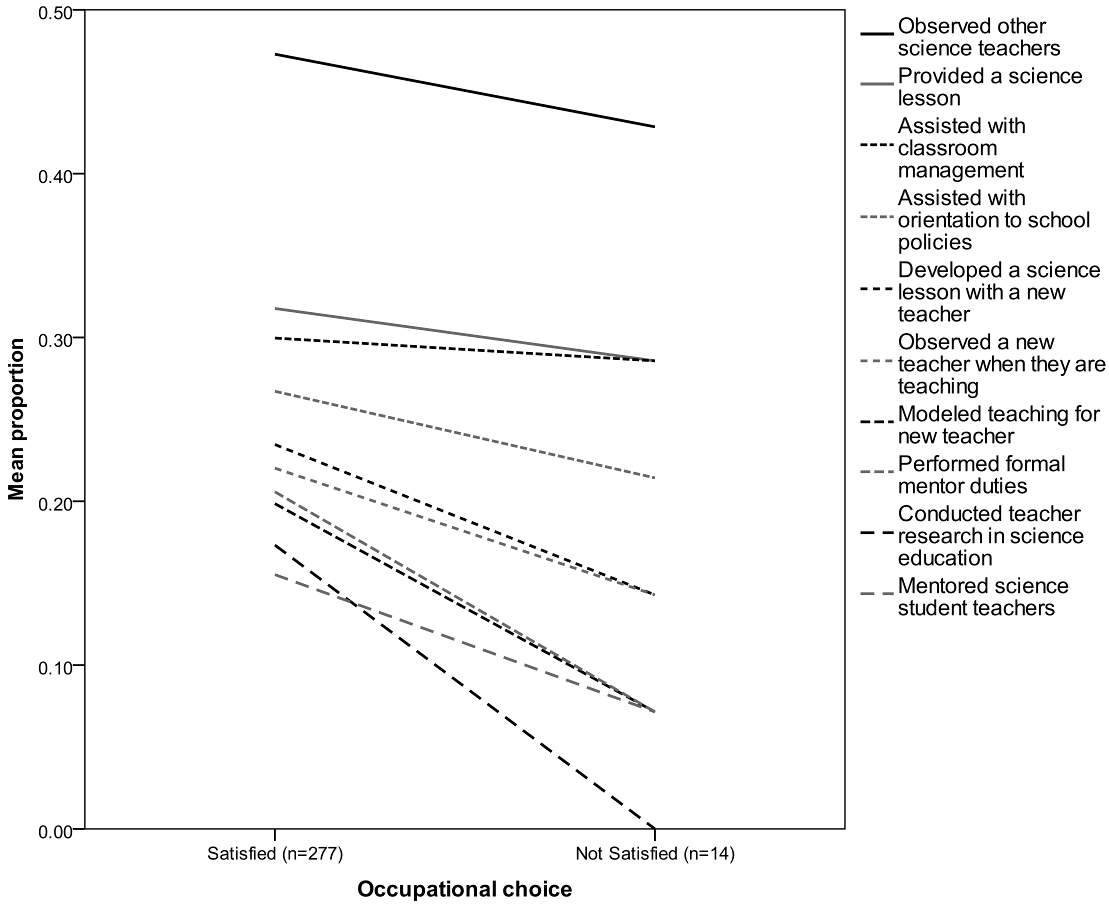

FIGURE 32. *The mean proportion of teachers, by satisfaction with occupational choice, participating in one of ten professional maintenance activities.*

The mean proportion of teachers' participating in professional management activities by satisfaction with occupational choice status are presented in Figure 33. For seven of the nine activities, teachers expressing satisfaction with their occupational choice participated in management activities at a higher rate than their counterparts expressing dissatisfaction with their occupational choice. The seven management activities included: (a) chaired science department, (b) wrote science curriculum, (c) sponsored science club, (d) recruited new teachers through formal interviews, (e) recruited new teachers through informal visits, (f) recruited new teachers through policy meetings, and (g) recruited new teachers through off-campus trips. These results demonstrate the interaction between teachers' decisions regarding participation in professional management activities, attitudes concerning occupational choice, and considerations about staying at their school.

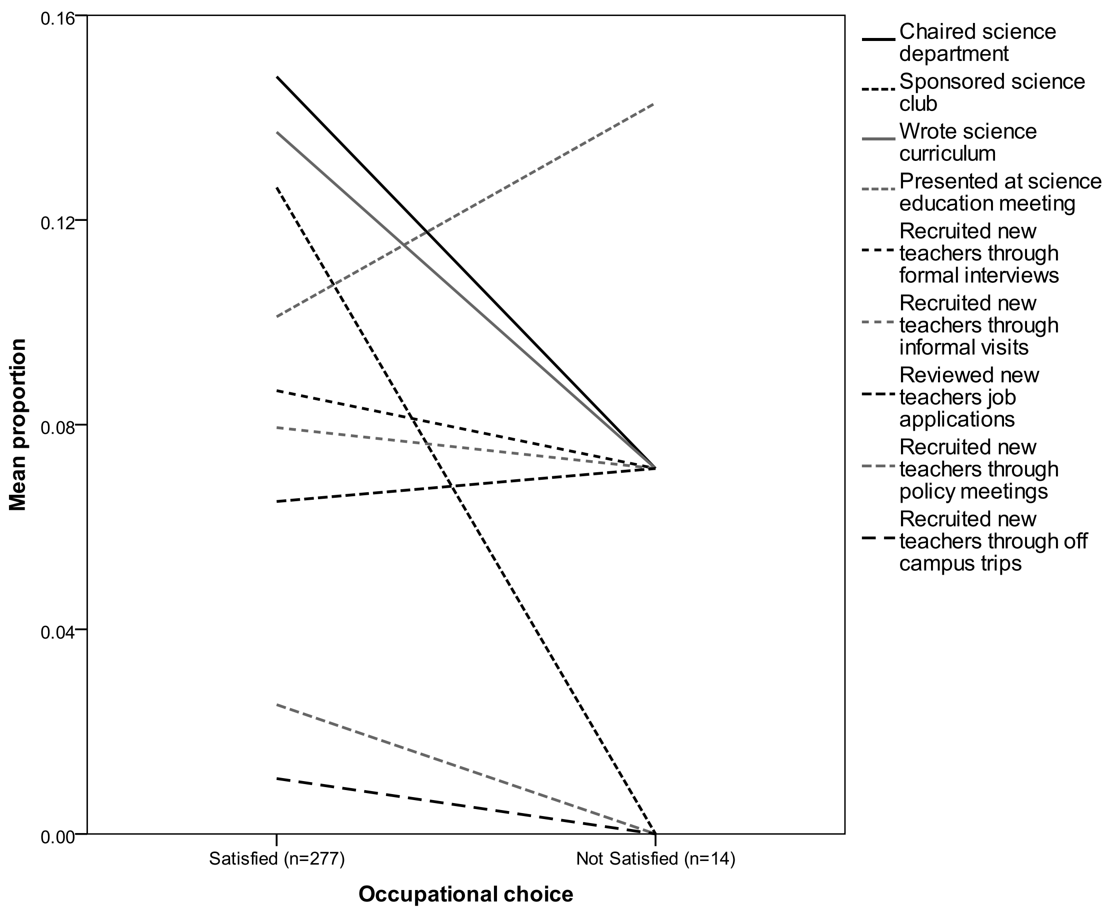

FIGURE 33. *The mean proportion of teachers, by satisfaction with occupational choice, participating in one of nine professional management activities.*

Research Question 3: What Are Retained Science Teachers Associations between Teacher Satisfaction with Occupational Choice and Participation in Professional Activities?

Overall, results from my previous analyses suggest that teachers are more likely to express satisfaction than dissatisfaction with their occupational choice. Additionally, teachers, regardless of satisfaction status, participate in professional development activities at similar rates. By contrast, previous analyses suggest teacher participation in professional maintenance activities is related to teacher satisfaction with occupational choice. Results from previous analyses further suggest we would not expect to observe any trend or associations between participation in development activities and satisfaction with occupational choice. The results in Figure 34 illustrate this expectation. Specifically, only teachers participating in science educator study groups are more likely to also express satisfaction with their occupational choice. The values and 95% CI for the remaining activities reveal no discernible trend or associations.

The results in Figure 35 illustrate a potential positive association between teacher participation in maintenance activities and satisfaction with occupational choice. Nine of the ten activities in Figure 35 imply that teachers participating in maintenance activities are more likely to be satisfied with their occupational choice. However, only one activity, conducting teacher research in science education, was both positive and significant.

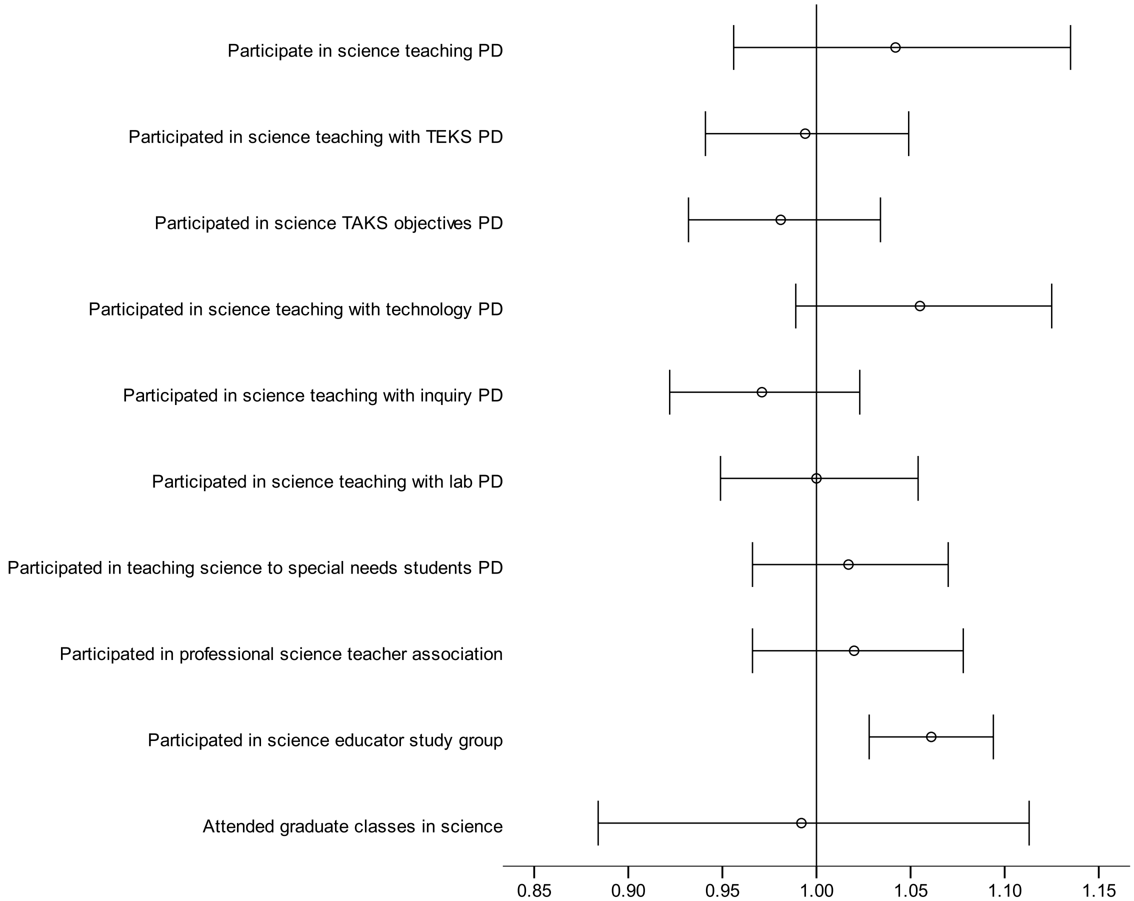

FIGURE 34. *Using the risk statistic to describe the likelihood of retained teachers participating in one of ten professional development activities will be satisfied with their occupational choice.*

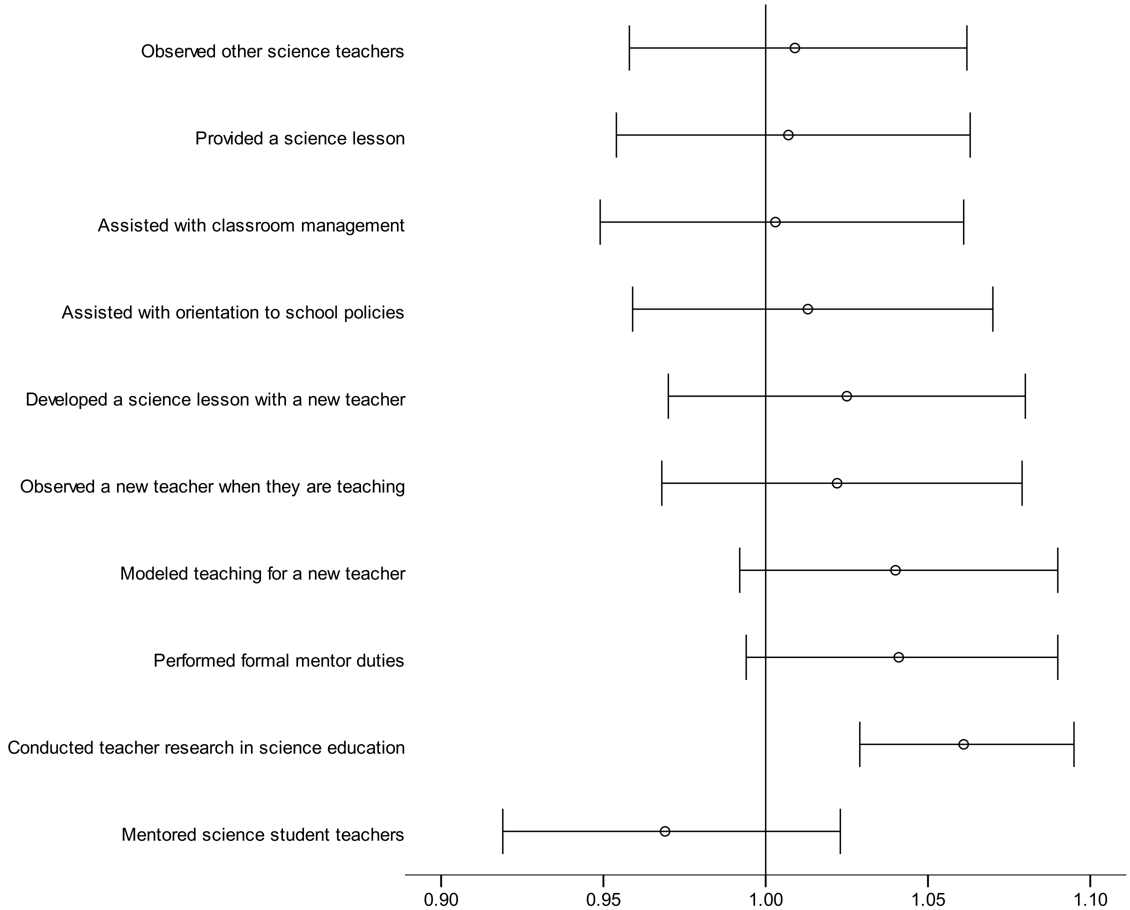

FIGURE 35. *Using the risk statistic to describe the likelihood of retained teachers participating in one of ten professional maintenance activities will be satisfied with their occupational choice.*

The results in Figure 36 illustrate a potential positive association between teacher participation in management activities and satisfaction with occupational choice. Five of the ten activities in Figure 36 imply that teachers participating in management activities are more likely to be satisfied with their occupational choice. Additionally, three of these activities, sponsored science club, recruited new teachers through policy meetings, and recruited new teachers through off campus trips, were both positive and significant.

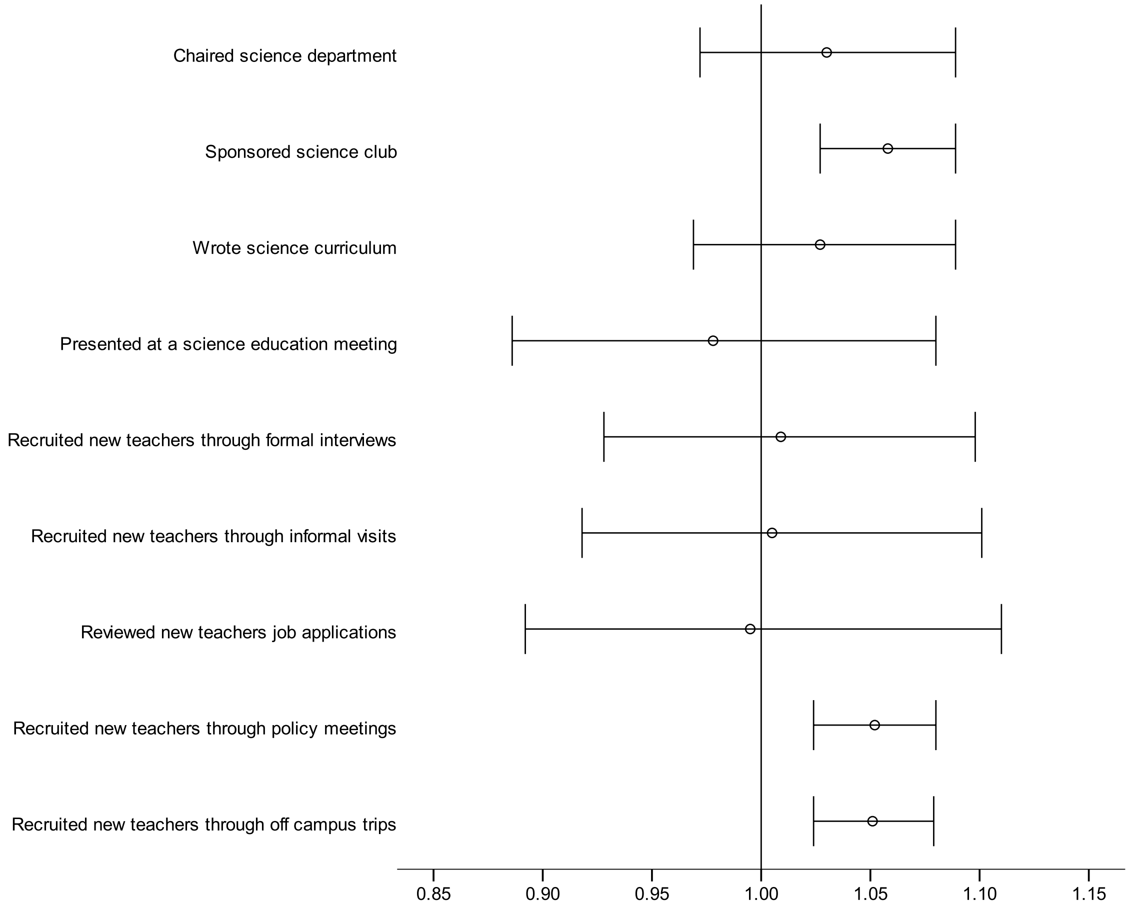

FIGURE 36. *Using the risk statistic to describe the likelihood of retained teachers participating in one of nine professional management activities will be satisfied with their occupational choice.*

Conclusions

An observational study is an appropriate method for describing retained teacher participation in professional activities and examining associative relationships between teacher participation and satisfaction with occupational choice. The analyses presented in this chapter increase our knowledge about teachers' satisfaction with occupational choice and the relationship between this teacher characteristic and their participation in professional activities. In particular, there is credible evidence that large numbers of retained teachers are satisfied with their occupational choice. Additionally, satisfied and dissatisfied teachers are equally likely to participate in professional development activities. Finally, teachers satisfied with their occupational choice are more likely to participate in professional maintenance and management activities than those teachers who are not satisfied with their occupational choice.

Policy Recommendations

How should these results inform policy? My analyses indicate that science teachers satisfied with their occupational choice are more likely to participate in professional activities designed around interpersonal relationships (i.e., mentoring, conducting research, and recruiting new teachers). These activities illustrate the need to include teachers in decision-making processes outside the classroom. Consequently, new policy should both offer opportunities to and encourage participation in professional activities requiring mentorship and leadership on the part of teachers. In addition, minimum standards for teacher participation in leadership roles should be outlined for individuals pursuing a teaching career. Finally, schools and their districts should review their current policies concerning the involvement of teachers in professional maintenance and management activities.

Limitations

This study has several potential limitations. First, some teachers responding to the TPSST survey taught in schools employing a single high school science teacher. Accordingly, bias toward schools employing only one science teacher could have led to incorrect probability assessments. However, these teachers made up a small percentage of the total sample and therefore their potential bias is likely negligible. Second, teacher job satisfaction is based on self-reporting, which theoretically could lead to bias in the data collection through incomplete or inaccurate participant recall. However, the use of an instrument designed by former high school science teachers, using language common to the science education profession, minimizes the impact of this potential bias. Third, teachers who left both their current school and the teaching profession one year after completion of the TPSST may have done so due to retirement. However, considering that the percentages of teachers leaving their current school and leaving the profession are similar in number, the author is confident this potential bias is also small. Fourth, as with all observational studies, unmeasured confounding factors could account for some of the observed relationships between teacher satisfaction with occupational choice and participation in professional activities. However, a broad data collection strategy, combined with statistical modeling of candidate variables, was designed to minimize this bias. Fifth and final, associative studies lack the ability to provide definitive causal outcomes most useful in making policy decisions. However, results from my research can inform the development of causal experimentations for future research.

Summary

In summary, my results suggest that teachers are generally satisfied with their occupational choice. For retained teachers, participation in multiple professional activities (e.g., conducting research in science education, sponsoring science clubs, and participating in a science educator study group) were positively associated with satisfaction. However, the professional activities (e.g., teaching science PD, teaching science with technology PD, and state standards of student learning) positively associated with occupational choice were generally not professional development activities. Instead, they were activities designed to increase personal expertise in the profession. Recognition of this fact will be important in considering future policy changes affecting opportunities for teachers to participate in professional activities.

CHAPTER VI

SUMMARY OF RESULTS AND POLICY RECOMMENDATIONS

Preparing today's students for tomorrow's society is a principal purpose of science education policy. Many researchers contend that "highly qualified" teachers are required to implement that policy. However, defining "highly qualified" is problematic at best, and improbable at its worst. I believe that "highly qualified" is as much a journey as a destination. I also believe "highly qualified" science teachers make precise decisions and possess certain characteristics. One of the decisions these teachers make is to participate purposefully in professional activities designed to improve their professional knowledge, maintain professional standards, and provide professional leadership. One of the characteristics these teachers possess is a satisfied affect towards their students, teaching colleagues, administrators, and school working conditions. Taken together, each decision made and characteristic possessed assists teachers in their journey to becoming "highly qualified."

The purpose of this summary chapter is fourfold. First, I briefly describe the sample of high school science teachers used in my analyses and make inference to the population of teachers in Texas from which the sample was drawn. Second, using information from my analyses, I review levels of teacher participation in specific professional activities and satisfaction with working conditions. Third, I examine the associative relationships observed between teachers' participation in professional activities and satisfaction with working conditions to school and professional retention.

Finally, I make specific recommendations for future policy to ensure that “highly qualified” science teachers both today and tomorrow are those who will teach our high school students.

The PRISE Sample and Inferences for Texas Science Teachers

Each of my analyses used the Policy Research Initiatives in Science Education (PRISE) sample of Texas high school teachers, either completely or in part. Each of the 385 teachers in the sample was responsible for teaching at least one state-defined high school science course, a prerequisite of selection for participation in the study. These teachers form the population of science teachers from a probabilistically chosen sample of 50 Texas high schools. Therefore, I believe that the values used to describe these teachers provide an excellent foundation for making inferences to the population of science teachers in Texas, estimated at approximately 10,000 teachers.

The PRISE Sample

Table 29 provides values of categorical measures describing the PRISE teacher sample. The information in Table 29 provides the reader with a descriptive snapshot of the personal and professional lives of sample teachers. For example, teachers were as likely to be male (48.5%) as female (51.5%), suggesting that long held beliefs about gender influence on teaching as a vocation or learning science may be coming to an end. Additionally, the largest ethnic group descriptor for teachers was White (73.0%). This value suggests that more still needs to be done to recruit ethnic minorities into the

TABLE 29
Categorical Measures Describing Personal and Professional Attributes of the PRISE Teacher Sample (n=385)

Measure type	Measure	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Personal	Gender				
	Male	181	47.0	48.5	48.5
	Female	192	49.9	51.5	100.0
	Missing	12	3.1		
	Total	385	100.0		
Personal	Ethnicity				
	American Indian	1	0.3	0.3	0.3
	Asian/Pacific Islander	8	2.1	2.2	2.5
	African American	19	4.9	5.2	7.7
	Hispanic American	71	18.4	19.3	27.0
	White	268	68.6	73.0	100.0
	Missing	18	4.7		
	Total	385	100.0		
Professional	School size				
	Small	26	6.8	6.8	6.8
	Medium	87	22.6	22.6	29.4
	Large	272	70.6	70.6	100.0
	Total	385	100.0		

TABLE 29 continued

Measure type	Measure	Frequency	Percent (%)	Valid Percent (%)	Cumulative Percent (%)
Professional	School minority status				
	Lowest	133	34.5	34.5	34.5
	Low	47	12.3	12.3	46.8
	High	70	18.2	18.2	65.0
	Highest	135	35.0	35.0	100.0
	Total	385	100.0		
Professional	Experience level				
	Induction	96	24.9	25.9	25.9
	Mid-career	61	15.8	16.5	42.4
	Veteran	213	55.3	57.6	100.0
	Missing	15	3.9		
	Total	385	100.0		

profession. Furthermore, the majority of teachers in this sample came from large schools (70.6%) having 900 or more students. This value would suggest that urbanization of schools in Texas is a major education factor. Finally, the majority of teachers were classified as Veteran (57.6%). This value suggests that more needs to be done to retain Induction and Mid-career teachers to satisfy recommendations that mixed professional cultures of teachers within schools provide (Kardos, Johnson, Peske, Kauffman, & Liu, 2001).

Table 30 provides values of continuous measures describing the teacher sample. As with Table 29, the information in Table 30 provides the reader with a snapshot of the personal and professional lives of these teachers. For example, the average age for a teacher in the sample was 43.4 years. However, a modal age of 29 years, standard deviation (SD) of 11.82, and Kurtosis value of -1.120, suggests that the majority of teachers in the sample were in their twenties. The average years of total experience for a teacher in the sample was 11.3, suggesting that on average most teachers were experienced in the profession. However, once again, the modal value (1.0) and SD (10.18) indicate that a majority of teachers in this sample have very little experience as professional educators. When reviewing school experience within a particular school, a similar pattern emerges. Specifically, a mean value of 6.5 years may lead to the

TABLE 30
Continuous Measures Describing Personal and Professional Attributes of the PRISE Teacher Sample (n=385)

Type	Measure	Mean	Median	Mode	Range	SD	Skewness	Kurtosis
Personal	Age	43.4	42.0	29.0	46.0	11.82	0.201	-1.120
Professional	Total experience	11.3	9.0	1.0	46.0	10.18	0.856	-0.099
Professional	School experience	6.5	3.0	1.0	37.0	7.09	1.956	3.897
Professional	Job satisfaction	42.0	42.0	40.9	34.0	6.30	-0.227	0.040
Professional	Number of professional activities	10.1	8.0	6.0	36.0	6.18	0.961	0.897

conclusion that teachers have extended experience in their school's classrooms; however, modal (1.0), SD (7.09), Skewness (1.956), and Kurtosis (3.897) values contradict this conclusion and indicate that only a minority of teachers have extended experience at their school. Measured on a scale between 14 and 52, the mean job satisfaction score of 42.0 with SD of 6.30, as measured by the *Texas Poll of Secondary Science Teachers* (TPSST), suggests a normal distribution of satisfied and dissatisfied teachers. This illustrates that individual teachers are variable in their affect towards the education profession. Finally, the TPSST measured teacher participation in 50 professional activities. The mean number of activities that teachers claimed involvement in was 10.1. This value implies that teachers participate in only a few of the activities described in the survey instrument.

Inferences for Science Teachers in Texas

If the PRISE teacher sample is a fair and accurate representation of the population of Texas high school science teachers, then it is possible to make some cautionary inferences. The following inferences reflect the personal and professional measurements discussed earlier. Personal measures from the sample suggest that Texas high school science teachers are as likely to be male as female, to more likely be categorized as White, and to be relatively young. Professional measures imply that a majority of teachers have little professional or school experience, express variability in their affect toward the education profession, and do not participate in professional activities at a high rate.

Participation in Professional Activities and Job Satisfaction

The TPSST measured teachers' participation in professional activities and satisfaction with their schools working conditions. This made it possible for me to describe teachers' participation in development, maintenance, and management activities as well as their general attitude about the schools where they teach. The following discussion presents a review of findings from Chapters III and IV. First, I will discuss results related to the sample and then make inference to teachers in Texas.

Participation in Professional Activities

Analysis of teachers' participation in professional activities was limited to 29 of the 50 activities listed in the TPSST. The activities I selected provide a diverse set of development, maintenance, and management activities in which teachers routinely participate. Results from Chapter III reveal that sampled teachers, in general, were most likely to participate in development activities and least likely to participate in management activities. Examples of activities teachers were most likely to participate in include; (a) science-teaching PD, (b) Texas Assessment of Knowledge and Skills (TAKS) objectives PD, (c) teaching with Texas Essential Knowledge and Skills (TEKS) PD, and (d) teaching with technology PD. Examples of activities teachers were least likely to participate in include; (a) recruiting new teachers through off campus trips, (b) recruiting new teachers through policy meetings, (c) reviewing new teachers job applications, and (d) presenting at science education meetings. These results suggest that teachers from the sample under study are most active in developing personal expertise and least active in providing professional leadership.

Job Satisfaction

Working conditions can describe the interpersonal relationships experienced by teachers in their school. Additionally, working conditions may include the facilities and equipment used by teachers as well as opportunities to expand their own professional expertise and scientific knowledge of students. The TPSST surveyed teachers' attitudes regarding 14 working conditions. Analysis of responses revealed that teachers were most likely to be satisfied with their occupational choice, colleagues, and administrators. In contrast, teachers were least likely to be satisfied with their laboratory equipment and facilities or school support for informal science activities.

Inferences for Science Teachers in Texas

The results from my analyses suggest that a majority of teachers in Texas are active in professional development activities, satisfied with their occupational choice, and satisfied with their colleagues and administrators. On the surface, these results would imply that teachers in Texas are experts in their chosen profession, content with their job, and enjoy working with their fellow professionals. However, each year Texas high schools lose as many as 2,500 of their 10,000 science teachers. Consequently, these factors are not likely to play significant roles in teacher retention. I will expand on this point in the next section.

Associative Relationships between Participation, Satisfaction, and Retention

Each year schools expend limited resources identifying and recruiting teachers to replace those lost to retirement and attrition. As a result, research has been conducted to identify reasons why teachers leave the classroom and methods to retain teachers in whom schools have invested resources. The PRISE research group measured teachers' retention from data collected by the Texas Education Agency (TEA). This made it possible for me to examine the associative relationships between teachers' participation in professional activities and retention as well as teachers' satisfaction with working conditions and retention. Of the 385 teachers in the original PRISE teacher sample, 75.6% (n = 291) stayed at their school the following year. For those teachers not staying at their school, 13.8% left the profession (n = 53) and 10.6% moved to another school (n = 41). The following discussion presents a review of findings from Chapters III, IV, and V that describe the correlations between teacher retention with participation in professional activities and satisfaction with working conditions. First, I discuss results related to the sample and then make inference to teachers in Texas.

Retention and Participation in Professional Activities

Each year schools expend limited resources for teachers to increase expertise, maintain standards of conduct, and provide leadership in the profession. When these teachers leave their school or profession prematurely, resources are wasted. Consequently, policymakers should be aware of the potential associative relationships between teachers' participation in professional activities and retention. Results from Chapter III reveal that the activities teachers were most likely to participate in were development activities (i.e., science-teaching PD, TAKS objectives PD, teaching with TEKS PD, and teaching with technology PD). Teacher participation in these activities were not associated with retention. In contrast, teachers active in maintenance activities were much more likely to stay at their school as well as in the profession.

In terms of individual activities, results from my analyses revealed positive and significant associations between five activities with retention at the school level and five activities with retention in the profession. The activities associated with school retention included; (a) participated in science educator study group, (b) mentored science student teachers, (c) observed other science teachers, (d) assisted with classroom management, and (e) assisted with orientation to school policies. The activities associated with retention in the profession included; (a) participated in science educator study group, (b) mentored science student teachers, (c) wrote science curriculum, (d) reviewed new teachers' job applications, and (e) recruited new teachers through off campus trips. Furthermore, these results indicate that teachers who take an active role in maintaining and managing their schools' learning environments are more likely to form the foundation of the future school and/or professional teacher populations.

Retention and Satisfaction with Working Conditions

Schools also use their limited resources to provide teachers with an environment in which to teach. My analyses in Chapter IV illustrated that school retention of teachers is not likely to be associated to their satisfaction with working conditions. In fact, the only association identified was a negative and significant association with ability to make decisions regarding instructional methods. This finding contradicts the generally held belief that a major source of teacher job satisfaction is autonomy. Similar results for retention in the profession were observed.

Retained Science Teachers, Participation in Professional Activities, and Satisfaction with Their Chosen Profession

As part of my research, I examined the associative relationship between satisfaction with occupational choice and participation professional activities for retained science teachers. I believe that teacher retention is a component within a complex system involving teachers, their schools, and the professional activities related to the profession. Consequently, Chapter V provided results from an analysis of only those 291 teachers retained by their school. The results imply a real and significant associative relationship between teacher satisfaction with their occupational choice and participation in professional activities for retained teachers at the school level. However, in contrast to the findings from Chapters III (i.e., participation in maintenance activities is associated with school retention) and IV (i.e., no association between teacher satisfaction and school retention), results in Chapter V reveal that teachers satisfied with their occupational choice are more likely to participate in management activities. These results imply that for my sub-sample of teachers, school retention was more likely to occur when teachers either were assigned or took advantage of opportunities to provide leadership at their school or in the profession.

Inferences for Science Teachers in Texas

Results from my analyses suggest that teacher participation in professional maintenance and management activities are most likely associated with teacher retention. However, participation in these activities on the part of most Texas teachers is likely to be very low. Additionally, satisfaction with their working conditions likely has more effect on teachers' decision to leave their current school than the profession at large. Exploration of how schools may make best use of this information to retain their "highly qualified" science teachers occurs in the next section.

Policy Recommendations

Policy, at any organizational level, attempts to hit a moving target called student achievement. It is not logical to assume that each student entering a high school science classroom will become a future scientist. However, I believe it is the responsibility of teachers to provide each student an opportunity to acquire scientific knowledge and become scientifically proficient (See Duschl, 2008, for a discussion of goals for scientific proficiency.). Research findings indicate that a student is most likely to acquire this knowledge when instructed by "highly qualified" teachers (Darling-Hammond, 1999; Desimone, Porter, Garet, Yoon, & Birman, 2002; Harris & Sass, 2007; Stuessy, Bozeman, & Ivey, 2010). Consequently, I make the following policy recommendations using results from my analyses.

Creation of education policy occurs at national, state, and local levels of organization. I analyzed 385 high school science teachers situated in 50 Texas high schools. Therefore, the recommendations made in this section will apply to either the state of Texas or local schools only. To assist the reader I identify the level for each recommendation.

Recommendations for Professional Activities

As I stated earlier, I believe that "highly qualified" is as much about the journey as the destination for teachers. Teachers' participation in professional activities marks the path of their journeys. Novice teachers require enormous amounts of professional development to acquire the necessary expertise to teach science in a high school classroom. However, once teachers achieve a standard of expertise they should and often do become more involved in the maintenance and management of their profession. Based on results from Chapters III and V I make the following four policy recommendations.

First, I recommend that the state explicitly define the types of development activities novice teachers should participate in to retain their teaching certificate. Second, I recommend that the state encourage experienced teachers (i.e., mid-career and veteran) to take a more active role in professional maintenance (i.e., observe other teachers in their classroom, mentor student science teachers, and participate in formal mentoring activities) and management (i.e., recruit new teachers by reviewing applications, participate in formal interviews, and attend job fairs) activities. Third, I recommend that schools persuade all teachers, regardless of experience, to participate in maintenance activities such as those mentioned earlier. Finally, I recommend that schools create and/or provide more opportunities for teachers to actively engage in professional management activities such as those mentioned above. I believe that implementation of these policy recommendations would lead to the creation of more “highly qualified” teachers who are more likely to remain at either their school or in the profession.

Recommendations for Working Conditions

Schools provide teachers a location and opportunities to become “highly qualified.” Current policy regarding school working conditions can be interpreted to reflect the early 20th century "factory model" that treat teachers as workers who mindlessly carry out a series of activities designed to impart facts to their students. I believe this policy mentality is a root cause for why teachers leave the classroom and profession prematurely. I recognize that schools have finite resources. However, I also believe that teachers are an important and often little used resource. Why should teachers, having expended massive amounts of time, energy, and resources, choose to remain in a school or profession that refuses to listen to their expertise? Based on results from Chapters IV and V I make the following four policy recommendations.

First, I recommend that the state set minimum standards for the equipment needed to teach high school science. Second, I recommend that the state encourage schools to have their students participate in informal science learning activities each year. Third, I recommend that schools support teachers in the acquisition of new and innovative equipment used for teaching science. Fourth, I recommend that schools support their teachers' participation in the acquisition of science equipment, maintenance of science teaching facilities, and inclusion of students in informal science activities. Once again, I believe that implementation of these policy recommendations would lead to the creation of more "highly qualified" teachers who are also more likely to remain at their school or in the profession.

Final Summary

In summary, science education is an important factor in the development of a free and informed society, a society that can look to the future with the hope of meeting and successfully overcoming the challenges of today. "Highly qualified" teachers possess professional expertise and provide evidence of commitment to the profession. These teachers are essential for implementing policy related to the science education of tomorrow's leaders and policymakers. However, these policies also influence the journey of our current teachers on their path to becoming "highly qualified." We, as members of today's society, are responsible for creating the learning environments in which teachers instruct our children. I believe that results from my analyses provide a framework for making changes to both state and school policies that will lead to more "highly qualified", satisfied, and professionally active teachers who are also more likely to remain in their classrooms.

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APPENDIX A

TEXAS POLL OF SECONDARY SCIENCE TEACHERS

1. (a) Have you formally participated in recruiting new science teachers since the fall of 2006? (Please enter a check on just one line below.)

____ Yes (If yes, go to question #1b.)

____ No (If no, go to questions #2.)

(b) Please indicate all of the ways that you have formally participated in the recruitment of new science teachers. (Please check all that apply).

____a. formal interviews at the school site

____b. informal visits with perspective science teachers

____c. recruitment trips outside school walls

____d. policy meetings specific to science

____e. review job applications for prospective science teachers

____f. Other (Please briefly explain).

2. (a) Have you participated in the induction/mentoring of new science teachers since the fall of 2006? (Please enter a check on just one line below.)

____ Yes (If yes, go to question #2b)

____ No (If no, go to question #3)

(b) Please indicate all of the ways that you have participated in the induction/mentoring of new science teachers. (Please check all that apply.)

____a. assisted with orientation to school policies

____b. assisted with classroom management

____c. observed a new science teacher teaching a science class

____d. modeled teaching for a new science teacher

____e. provided a new science teacher with a science lesson

____f. developed a science lesson with a new science teacher

____g. performed formal mentoring duties with a new science teacher

____h. other (Please briefly explain.)

3. (a) Since the fall of 2006, have you served in a leadership role? (Please enter a check on just one line below.)

____ Yes (If yes, go to question #3b)

____ No (If no, go to question #4)

(b) Please indicate the leadership roles you have held since the fall of 2006. (Please check all that apply).

____ a. Science department chair

____ b. Science curriculum writer

____ c. Science club/organization sponsor

____ d. Mentor to a science teacher

____ e. Member of a science teacher professional organization

____ f. Presenter at a science workshop, conference, or training session

____ g. Mentor to a teacher who is not science teacher

____ h. Subject team leader in a subject other than science

____ i. Member of a teacher professional organization that is not specifically science-related

____ j. Member of a district-level decision-making committee

____ k. Other leadership role. (Please specify below.)

4. Since the fall of 2006, in which of the following types of professional development opportunities have you participated? (Please enter a check in all lines below that apply to you.)

____ a. Strategies for teaching science content

____ b. Strategies for teaching science using technology

____ c. Strategies for teaching science using the Texas Essential Knowledge and Skills (TEKS)

____ d. Strategies for preparing students to master the Texas Assessment of Knowledge and Skills (TAKS) objectives

____ e. Strategies for teaching science to students with special needs

____ f. Strategies for the use of laboratory in teaching science

____ g. Strategies for teaching science by inquiry

____ h. None of the above

____ i. Other. (Please specify below.)

5. (a) Since the fall of 2006, in which of the following activities have you engaged that were specific to science or science education? (Please enter a check in all lines below that apply to you.)

____ a. Teacher research on innovative practice in science
____ b. Peer observations of other science teachers
____ c. Graduate studies in a science-related field
____ d. Educator study groups in science
____ e. Professional science teaching associations
____ f. Curriculum writing in science
____ g. Mentoring of science student teachers
____ h. Other (Please specify below.)

(b) Since the fall of 2006, in which of the following professional activities have you engaged that were not specific to science? (Please enter a check in all lines below that apply to you.)

____ a. Teacher research on innovative practice in a content area other than science
____ b. Peer observations of teachers other than science teachers
____ c. Graduate studies in an area that is not science related
____ d. Educator study groups in a content area other than science
____ e. Teaching professional associations that are not science specific
____ f. Curriculum writing in a content area other than science
____ g. Mentoring of student teachers in content areas other than science
____ h. Other (Please specify below.)

6. In a typical semester, how often do you informally meet (that is, not during a scheduled science department meeting) with other science teachers at your school about issues related to classroom science teaching? (Please enter a check on just one line below.)

____ a. Daily

____ b. Once a week

____ c. Twice a week

____ d. Once a month

____ e. Twice a month

____ f. Once a semester

____ g. Twice a semester

____ h. Almost never

7. Overall, how satisfied are you with your decision to become a high school science teacher? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

8. How much do you agree with this statement: Improving student achievement in science is a team effort at this school? (Please enter a check on just one line below.)

____ a. Strongly agree

____ b. Agree

____ c. Disagree

____ d. Strongly disagree

9. How satisfied are you with the level of cooperation and collegiality among all the teachers at this school? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

10. How satisfied are you with the way your science program contributes to the career development of students at this school? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

11. How satisfied are you with the decisions you can make about the instructional methods you use in your own science classroom? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

12. How satisfied are you with the support you receive from the school to have your students attend informal science activities, such as field trips, visits to museums, and off-campus activities at informal science institutions? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

13. How satisfied are you with the options that you have at your school for participating in science-specific professional development? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

14. How satisfied are you with the support provided by your school for you to participate in professional development? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

15. How satisfied are you with your science laboratory facilities? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

16. How satisfied are you with your science laboratory equipment? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

17. How satisfied are you regarding the recognition you receive for your science teaching efforts at this school? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

18. How satisfied are you with your current teaching assignment? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

19. How would you rate your personal level of safety at this school? (Please enter a check on just one line below.)

____ a. Excellent personal safety

____ b. Good personal safety

____ c. Fair personal safety

____ d. Poor personal safety

20. How satisfied are you with the administrative communication you receive about expectations for your teaching in this school? (Please enter a check on just one line below.)

____ a. Very satisfied

____ b. Satisfied

____ c. Dissatisfied

____ d. Very dissatisfied

21. Please provide your full name.

First Middle Last Maiden (if applicable)

22. Including this year (2007-2008) as one year, how long have you taught science at this school? (Please enter the number of years in the box below.)

[ ] # of years

VITA

Todd Dane Bozeman received his Bachelor of Science in biology from Lubbock Christian University in 1993. He then spent eight years as a science and mathematics teacher in both public and private high schools. He entered the Curriculum and Instruction program at Texas A&M University in Spring 2002 and received his Master of Education degree in May 2005. Since 2006, Mr. Bozeman has been a research fellow in the Policy Research Initiatives in Science Education (PRISE) Research Group. His research interests include the role of state and local policy on science education and the application of mathematical modeling on school social structures. He plans to publish a book in these topics, focusing on Texas public high schools.

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