Denver ProComp:

An Outcomes Evaluation of Denver's Alternative Teacher Compensation System

2010 Report

Edward W. Wiley, Eleanor R. Spindler, & Amy N. Subert
University of Colorado at Boulder
School of Education

CONTENTS

REPORT SUMMARY 6
CHAPTER I: Background and Overview 10
Context of Alternative Teacher Compensation 10
Denver Public Schools and ProComp 11
Report Structure 12
CHAPTER II: Outcomes Associated with the ProComp Program 14
Introduction 14
Review of Literature 14
Teacher "Effects" as Measures of Teacher Quality 14
Alternative Compensation and Student Achievement 15
Methodology 16
Data and Measures 16
Conditional Growth Percentiles 16
Value-added "Effect" Estimates 18
Modeling Achievement on ProComp Participation 18
ProComp Survey Data 19
DPS Aggregate Student Achievement Trends 19
Student Achievement 21
Productivity Effects 21
Composition/Selection Effects 24
Discussion: Student Achievement 26
General Attitudes about ProComp 27
Attitudes about the Traditional Salary Schedule Relative to ProComp 30
Attitudes Regarding ProComp's Effects on Student Achievement 35
Attitudes Regarding ProComp's Effects on Instructional Behaviors 36
Discussion: Principal and Teacher Attitudes toward ProComp 37
CHAPTER III: Teachers Attitudes, Behaviors, & Student Achievement 38
Introduction 38
Conceptual Framework & Review of Literature 38
Methodology 41
Participants 41
Data Sources 43
Measures 43
Analytic Approach 44

Findings 44
Discussion 50
CHAPTER IV: ProComp and Retention in Hard-to-Serve Schools 51
Introduction 51
Review of Literature 52
Methodology 54
Population 54
Data Sources 58
Analytic Approach 60
Findings 61
Discussion 67
CHAPTER V: Conclusion 70
Summary of Findings 70
Limitations 71
Directions for further research 72
REFERENCES 74
Appendix A: ProComp Incentives Chart: 2005-06 – 2007-08 80
Appendix B: ProComp Incentives Chart: 2008-09– to Present 80
Appendix B: ProComp Incentives Chart: 2008-09– to Present 81
Appendix C: Correlations of Instructional Behavior Items 82
Appendix D: Correlations of Attitudinal Items 83
Appendix E: Factor Analysis of Behavior 84
Appendix F: Factor Analysis of Attitude 87
Appendix G: Models Predicting Behavioral Change 90
Appendix H: Hard-to-Serve School Eligibility (2008-09 to Present School Year) 93
A. Payment Eligibility 95
B. Payment Amount 95
Appendix I: Hard-to-Serve School Eligibility (2006-07 to 2007-08 School Years) 96

FIGURES

Figure 1. Distribution of teacher median conditional growth percentiles, 2002-03 to 2008-09. . 20
Figure 2. DPS average teacher median conditional growth percentiles: 2002-03 to 2008-09. 21
Figure 3. Comparison of reading achievement effect trends by opt-in cohort (incumbents as of 1/1/06). 22
Figure 4. First-year achievement of teachers new to DPS (by entry cohort). 24
Figure 5. Teachers' median student conditional growth in initial years after hire: Reading. 25
Figure 6. Teachers' median student conditional growth in initial years after hire: Mathematics. 26
Figure 7. Logic model of relationships between teacher attitudes, behaviors, and student achievement. 40
Figure 8. Prototypical plot for selected linear model (reading). 49
Figure 9. Teachers eligible for ProComp and sample included in retention analyses. 55
Figure 10. Sample schools included in retention analysis. 57
Figure 11. ProComp participation over time. 62
Figure 12. Within-school retention trends for the district. 64
Figure 13. Within-school retention trends for the district, disaggregated by ProComp participation. 65
Figure 14. Within-school retention trends for the district, disaggregated by HTS status. 66
Figure 15. Within-school retention trends for the district, disaggregated by ProComp participation & HTS status. 67

TABLES

Table 1. DPS mean teacher conditional growth percentiles: 2003-2009. 19
Table 2. Reading achievement trends for ProComp opt-in cohorts: 2002-03 to 2008-09.[1] 22
Table 3. Estimates from longitudinal mixed-effects model of Conditional Growth Percentiles on ProComp opt-in 23
Table 4. Beliefs of teachers regarding the effectiveness and appropriateness of ProComp. 28
Table 5. Beliefs of principals regarding the effectiveness and appropriateness of ProComp 29
Table 6. Teachers' beliefs about traditional salary schedule 30
Table 7. Teachers' beliefs about traditional salary schedule 31
Table 8. Teachers' beliefs about traditional salary schedule 31
Table 9. Teachers' beliefs about traditional salary schedule 32
Table 10. Teachers' beliefs about traditional salary schedule. 33
Table 11. Beliefs of principals about ProComp relative to traditional salary schedule 34
Table 12. Beliefs of teachers about ProComp and student achievement. 35
Table 13. Beliefs of principals about ProComp and student achievement. 36
Table 14. Beliefs of teachers about ProComp and instructional practices. 36
Table 15. Beliefs of principals about ProComp and instructional practice. 37
Table 16. Demographic characteristics of respondents. 42
Table 17. Influence of ProComp to change teacher behavior. 45
Table 18. Teacher attitudes toward ProComp. 46
Table 19. Estimates for selected linear model (reading). 48
Table 20. Changes in HTS bonus from first to second iteration of ProComp. 58
Table 21. Human resource variables. 59
Table 22. School characteristic variables. 60
Table 23. Transitions between school years. 60
Table 24. ProComp participation over time. 63
Table 25. Average yearly change in ProComp participation. 63
Table 26. Quartiles of ProComp participation in 2008-09 63

REPORT SUMMARY

Denver's *Professional Compensation System for Teachers* ("ProComp") is among the most prominent alternative teacher compensation reforms in the United States. Although teacher compensation that departs from the traditional "single-salary schedule" [1] is not new, it has recently gained popularity again in policy circles as an approach for increasing student achievement and improving teacher quality. Accordingly, two primary goals of ProComp are to: 1) increase student achievement; and 2) attract and retain high-quality teachers to the district.

This is the first of two reports detailing possible effects of Denver's ProComp on student achievement, educator attitudes and behaviors, and teacher retention. This first report describes outcomes that may be associated with ProComp at the program level; a subsequent report (to be released in September, 2010) describes outcomes at a finer level of granularity to better understand differential outcomes of the program's various elements for educators of various backgrounds.

The following questions guide analyses presented in the pages to come:

I. ProComp Program Impacts

1. What trends characterize student achievement in the years prior and subsequent to ProComp implementation? To what degree might changes in these trends be associated with ProComp?
2. To what degree do aggregate achievement outcomes differ for teachers who participate in ProComp relative to those who have not joined ProComp?
    a. Do these outcomes differ for teachers who joined ProComp voluntarily and those who were required to join ProComp due to their hire date?
    b. Does evidence specifically support either *compositional* effects or *productivity* effects associated with ProComp?
3. What do teachers and principals report regarding their attitudes and beliefs about ProComp?
    a. How do beliefs about ProComp compare to beliefs about the traditional salary schedule?
    b. To what extent do teachers and principals believe ProComp has the ability to increase student achievement and improve instructional behaviors?

[1] Broadly conceived, alternative teacher compensation includes pay structures that differ from the traditional salary schedule that provides teachers with pay increases according to their years of teaching experience and post-baccalaureate educational attainment. Alternative pay structures include pay-for-performance and merit pay programs that pay teachers for performance outcomes, professional development, and other desirable behaviors.

II. ProComp Attitudes, Instructional Practice, and Achievement

1. To what extent are teachers' beliefs about the efficacy and fairness of ProComp associated with reported changes in their instructional practices, conditioned on aggregate student achievement gains?

III. ProComp and Retention in Hard-to-Serve Schools

1. To what extent might implementation of ProComp and the availability through ProComp of the Hard-to-Serve incentive account for changes in retention trends at hard-to-serve schools?

In particular, key findings include:

District-wide student achievement trends

- Growth in mathematics and reading achievement has increased substantially from 2002-03 to 2002-09.
- Teachers' median conditional growth percentiles have seen a 3-8% increase over the last eight years, based on a conditional achievement measure similar to that of the Colorado Growth Model.
- Trends are similar as measured in value-added teacher "effect" estimates.

Student achievement outcomes

- *Some evidence of ProComp composition/selection effects*
    - Teachers hired after the implementation of ProComp (subsequent to which program participation has been mandatory) exhibit higher first-year achievement than those hired prior to the program.
    - This finding is:
        - Positive for both mathematics and reading
        - Consistent across school levels (though more pronounced at elementary level)
        - Outcomes similar regardless of whether measured in terms of conditional growth percentiles or more common estimated value-added achievement effects
- *Less evidence of ProComp productivity effects*
    - Teachers who have voluntarily opted into the ProComp program slightly outperform their non-participant colleagues, though differences are less pronounced when adjusted for individual differences between teachers who choose to participate and those who do not. Mixed effects models offer little evidence of significant changes in effects for voluntary participants after implementation compared to the effects before implementation

Teacher and principal attitudes

- *Teachers*:
  - Generally, teachers who participate in ProComp hold more favorable views of ProComp than those who are not in ProComp
    - Teachers who voluntarily entered ProComp are most supportive of the program
    - Teachers who were automatically enrolled in ProComp (due to joining the district after January 1, 2006) reported attitudes that were more similar to voluntary participants than to the attitudes of teachers who were not in ProComp (This suggests positive selection into DPS for new teachers.)
  - A majority of ProComp participants indicated that they believed the ProComp program could motivate teachers to improve instructional practices, with positive respondents outnumbering negative responses by a 3-to-1 margin.
  - Participants indicating that the ProComp program would ultimately improve student achievement outnumbered those who disagreed by a 2-to-1 margin.
  - Participants were evenly split regarding whether they believed ProComp had improved teacher collaboration.
- *Principals*:
  - Generally, principals reported more favorable beliefs about ProComp than did teachers
    - More also reported favorable beliefs about ProComp than about the traditional salary schedule
  - In a pattern opposite that of teachers, more principal respondents believed ProComp could increase student achievement than believed ProComp could improve instructional behaviors

Attitudes, Instructional Behaviors, and Student Achievement

- Teachers who reported favorable attitudes towards ProComp were more likely to report they had changed their instructional behavior and practices
- The relationship between favorable attitudes toward ProComp and reported changes in instructional behaviors persisted regardless of whether models included controls for prior achievement history
- Changing the way attitudes were conditioned on prior achievement resulted in different effects on reported changes of instructional behavior
  - Teachers' percentages of high-growth students (students with student growth percentiles above the 55th percentile) had little relation to teachers' reported changes in their instructional behaviors
  - Greater relationships appeared between changes in teachers' instructional behaviors and percentages of students with high-growth students than between instructional behaviors and the dichotomous distinction of an effective teacher
    - Suggests prior student achievement gains that occur around the 55th percentile may be more influential on teachers' attitudes

Retention in Hard-to-Serve Schools

- Over the past decade, DPS has generally experienced an upward trend in teacher retention
- Schools with greater rates of ProComp participation have experienced higher rates of retention in recent years
- Retention trends at hard-to-serve schools lag behind those of schools that are not designated "hard-to-serve"
- Schools with greater rates of ProComp participation that are designated "hard-to-serve" experienced a sharp increase in retention rates in the first full year ProComp was implemented (2006-07)
    - These schools also saw the greatest increase in retention (from 74% to 86%) over the past decade
    - Suggests there may be a positive effect on retention trends associated with ProComp and the hard-to-serve bonus

This study is observational (rather than experimental) in nature. Where possible we've employed quasi-experimental techniques toward the goal of understanding ProComp's causal effects. That said, interpretation of results must be carried out with consideration of potential study confounds and limitations (several of which are detailed in Chapter V).

CHAPTER I: Background and Overview

At its most basic, alternative teacher compensation is intended to align the interests of teachers with the goals of the district in which they work (Adams et al., 2009). Alternative teacher compensation programs have attracted bipartisan support in policy discussions as an approach to increase student achievement and attract and retain high-quality teachers (Baratz-Snowden, 2007). The Obama administration and Congress recently passed the American Recovery and Reinvestment Act of 2009, which provided additional financial support to the Teacher Incentive Fund (TIF) (Hoff, 2008). Created in an appropriations bill in 2006, TIF initially provided $99 million in competitive five-year grants to states, school districts, and nonprofit organizations that support "efforts to develop and implement performance-based teacher and principal compensation systems in high-need schools" (U.S. Department of Education, 2008, N.P.). The American Recovery and Reinvestment Act of 2009 added another $200 million in funding to support these programs (Chiat & Miller, 2009; Sawchuk, 2009).

This chapter situates our analyses of Denver's ProComp by briefly describing both a historical and current context for alternative teacher compensation programs. Following this, we present relevant background information about the Denver Public School District and ProComp. Lastly, we detail the organizational structure of this report.

Context of Alternative Teacher Compensation

Since the early 20th century, a vast majority of public school teachers have been paid based on years of experience and education level – often referred to as the "step-and-ladder" system or the "single-salary" schedule (Conley & Odden, 1995). This is a system of uniform pay steps that ensures teachers with the same years of experience and same level of education earn the same salary within a given district. Early efforts to develop and implement teacher compensation programs that differed from the single-salary schedule struggled with creating a reliable process to identify effective teachers, developing standardized assessments across schools, ensuring fair treatment during supervisor evaluations, fulfilling administrative duties, and stretching limited funds (Baratz-Snowden, 2007; Buddin et al., 2007; Harris, 2007; Murnane & Cohen, 1986; Podgursky & Springer, 2006). These problems echo many of the concerns about alternative teacher compensation programs today. Yet, despite these persistent challenges, there has been a recent surge in interest in these programs.

Proponents of alternative teacher compensation argue developments in educational research and data collection may make this latest round different from earlier movements. In the first publication of a series on alternative teacher compensation by the Economic Policy Institute, Adams et al. (2009) explain there are three important developments in the study of K-12 education that have contributed to the renewed interest in alternative teacher compensation programs. First, a large body of empirical research exists today suggesting teachers are the most important school resource to influence student achievement. Second, districts now collect data that enable them to link student achievement measures to individual teachers. Finally,

sophisticated statistical models of teacher "value-added" have been developed that many think provide accurate estimates of teacher effectiveness.

The most prominent types of alternative teacher compensation include: knowledge- and skill-based pay, merit- or performance-based pay, and market-based pay (Milanowski, 2002; Podgursky & Springer, 2006). ProComp draws on each of these types of alternative teacher compensation, resulting in a comprehensive program that provides financial incentives to teachers for a variety of tasks, skills, jobs, and outcomes.

Denver Public Schools and ProComp

Denver Public School District (DPS) is the second-largest school district in Colorado, serving approximately 78,352 students in 152 schools with roughly 4,500 teachers. The majority of students who attend DPS are Latino and roughly 70 percent qualify for the federally sponsored free- and reduced-price lunch program, a commonly used indicator of poverty. Like many large, urban districts, DPS is plagued with low student achievement and a shortage of high-quality teachers. In the last decade, DPS has tried to address these issues via numerous education reform measures – school choice, charter schools, reconstitution of low-performing schools, and alternative-certification teacher programs. Of these reforms, alternative teacher compensation has received the most attention.

DPS has a long history of leadership in teacher compensation reform. In 1921 DPS became one of the first school districts in the nation to pay teachers with a single-salary schedule, the basis on which the majority of teachers in the United States are now paid (Gratz, 2009). In 1994, DPS created a committee to begin looking at alternative ways to compensate teachers and by 1999 a two-year alternative teacher compensation pilot plan had been developed (Gonring, Teske & Jupp, 2007). Backed by several prominent Denver foundations with interests in education, this pilot plan was later extended to four years. In 2004, DPS made several adjustments to the plan based off strengths and weakness highlighted in an evaluation report conducted by the Community Training and Assistance Center (Gonring, Teske & Jupp, 2007). The final plan – known as "ProComp", *Denver's Professional Compensation System for Teachers*, was approved by teachers and financially backed by Denver voters in 2004 and 2005.

Historically, alternative teacher compensation plans have been met with fierce resistance from teachers unions (Harris, 2007). The apparent success of Denver in overcoming much of the political opposition from the teachers union was likely due to the partnership between DPS and the teachers union – the Denver Classroom Teachers Association (DCTA), an affiliate of the National Education Association (NEA) – in developing the pilot and final ProComp plan (Baratz-Snowden, 2007).

ProComp also came about at a time when the federal government began to show interest in financially supporting alternative teacher compensation plans. The Bush administration prioritized teacher compensation reform, allocating nearly $100 million to alternative compensation systems through its Teacher Incentive Fund (TIF) program. Denver's ProComp

received a $22.6 million TIF grant and was backed by Denver voters via a 2005 referendum to levy $25 million in annual taxes to pay for the program.

Fully implemented throughout DPS in 2006, incumbent teachers could opt into ProComp or continue to be paid based on the single salary schedule (see Appendix A). Teachers who were new to DPS and hired on or after January 1, 2006, were required to participate in ProComp. Under the ProComp compensation program, teachers can receive salary increases and/or bonuses by doing one or more of the following: obtaining advanced degrees and certifications, completing specialized professional development, demonstrating proficient practice through a newly designed Comprehensive Professional Evaluation system, working at a hard-to-serve school or in a hard-to-staff position, meeting classroom learning objectives, exceeding student achievement expectations on the state assessment, working in a school with distinguished achievement and/or by working in a school for which the rate of growth toward distinguished student achievement and attendance is rated "high" (see Appendix B). There is no limit to the number of incentives a teacher can learn in a single year; however some are specific to subject/grade taught or school location. The comprehensive design of ProComp has been championed by President Obama as a model for design and implementation of teacher compensation reform, and a growing number of districts have used ProComp as a guide for developing similar reforms (Meyer, 2008).

ProComp received national attention in summer, 2008, because of tense district-union negotiations on how to best allocate available funding (Hanowar, 2008a; 2008b). Shortly before the start of the 2008-09 school year, a compromise between the district and the union was agreed upon, resulting in two new bonuses and changes in incentives attached to several elements (see Appendix B).

Though originally conceived as a standalone program (albeit a complex one), ProComp's passage coincided with the development of the "Denver Plan", an extensive strategic plan for improving student achievement outcomes (Denver Public Schools, 2005; 2010). Initially detailed in a 106-page draft (Denver Public Schools, 2005), the Denver Plan represented a collection of strategies supporting the "Relentless Pursuit of Student Achievement". The Denver Plan relied substantially upon ProComp to help achieve the primary goal of attracting and developing a "highly-skilled faculty in every school". As such, experiences and outcomes associated with the ProComp program cannot be considered in isolation, but rather as part of a comprehensive initiative toward improving student achievement.

Report Structure

This report presents information from analyses of several aspects of ProComp through its fourth year of implementation. In the pages that follow we describe five sets of analyses that contribute to our ongoing understanding of student achievement and teacher retention effects associated with ProComp.

Chapter II details analyses examining several outcomes associated with ProComp. First, we set the stage for ProComp analyses by detailing in aggregate trends in student achievement and

teacher "effects" over the last eight years. Next, we take up the question of the degree to which student achievement gains might reflect compositional/selection effects and/or productivity/motivation effects associated with the program. We end this chapter by detailing teacher and principal attitudes toward ProComp and the traditional salary schedule.

Chapter III reports results of initial analyses drawing on linked teacher survey and achievement data to explore the extent to which ProComp teachers' attitudes about ProComp and their previously demonstrated student achievement gains are associated with reported instructional practices and behaviors. Chapter IV focuses on one specific incentive available under ProComp – the Hard-to-Serve bonus – and examines the extent to which the availability of this incentive might have accounted for changes in teacher retention.

Finally, Chapter V presents some conclusions, limitations of these analyses, and directions planned for further research.

CHAPTER II: Outcomes Associated with the ProComp Program

Introduction

This chapter details the results of analyses examining changes in student achievement since Denver's implementation of ProComp. One of the first and most innovative district-wide performance pay programs in the United States (Podgursky & Springer, 2007a; 2007b), ProComp has been looked to as a model for many states' applications for substantial awards through the Department of Education's *Race to the Top* program (Honawar, 2008, July 30). Although descriptive studies have addressed early achievement differences between ProComp and non-ProComp teachers (Wiley, et al, 2008; Wiley, et al., 2007), this is the first analysis that attempts to isolate causal effects associated with the program. To ground the findings regarding student achievement, this chapter also details teachers' and principals' attitudes towards and beliefs about ProComp.

Review of Literature

Teacher "Effects" as Measures of Teacher Quality

Several studies have demonstrated variability in achievement "effects" across teachers (Darling-Hammond, 2000; Wright, Horn, & Sanders, 1997; Rivkin, Hanushek, & Kain, 2005). In a recent review of ten studies of teacher achievement effects, Hanushek and Rivkin (2010) found average standard deviations of teacher effects of 0.13 for reading and 0.17 for math. Moreover, the residual effects associated with spending a year with a less effective teacher appear to extend into future years, even if those years are spent in the presence of more effective teachers (Sanders & Rivers, 1997).

Though many such studies have documented variability in estimated teacher effects, until recently few studies have examined the *validity* of such effects as measures of teacher effectiveness. Two recent studies provide reason for encouragement in this area. Kane, et al. (2010) recently found value-added teacher effects to be related to teachers' scores on a classroom-based teacher effectiveness assessment based on the well-known "Danielson framework". In the only study of its kind, Taylor, et al. (2010) found systematic relationships between value-added teacher effect estimates and reading assessment outcomes in a comparison of monozygotic and dizygotic twins. Though these studies provide early evidence that value-added teacher effects reflect actual teacher 'effectiveness', more study is clearly needed before such a link can be fully established.

Alternative Compensation and Student Achievement

Although promises of increased student achievement are often used to justify performance pay programs (e.g., U.S. Department of Education, 2006), little research exists to document their effectiveness in realizing such promises. A review by Podgursky and Springer (2008) identified only ten studies of incentive pay programs that attempted to isolate a causal effect on student achievement; considered together these studies failed to support any clear inferences regarding achievement effects associated with performance pay programs. Though the authors report positive effects for the majority of studies, the programs themselves varied substantially enough in incentive design, in their strategies for isolating the causal effects of their programs, and in the magnitude and stability of estimated effects, to prohibit any clear inferences regarding achievement effects associated with performance pay programs. Since that review, a few noteworthy evaluations have added to the research base on teacher performance pay (e.g., Glazerman, et al., 2009; Hezel Associates, LLC, 2009; Martins, 2009; Springer & Winters, 2009; Springer, et al., 2008), though the magnitude and stability of effects reported in these studies tend to be mixed as well.

Agency theory (Ross, 1973; Holmstrom, 1979; see Eisenhart, 1989) motivates much of the theoretical basis supporting teacher incentive programs. In particular, the work of both Holmstrom and Milgrom (1991) and Lazear (2003) suggest multiple channels though which performance incentives may improve student outcomes in the case of teacher compensation. Lazear (2003) suggested that providing incentives for increasing student achievement scores may ultimately raise student achievement via two mechanisms: by providing a basis for *motivation* toward improving student achievement through changes in professional practice (often referred to as a "productivity" effect); and by improving the *composition* of the teacher workforce through selection of teachers best suited to improve student achievement. This second mechanism is thought to operate through attraction and retention of higher-quality teachers and attrition of teachers less likely to positively affect student achievement (often termed a "selection" effect). The work on imperfect performance measurement (such as using student test scores as a measure of student learning) in multitask settings (Baker, 1992; Holmstrom & Milgrom, 2003), however, would suggest that, faced with multiple tasks, teachers might focus inordinately on efforts leading to test score increases (e.g., "teaching to the test") to the detriment of activities benefiting student learning in other important, yet less easily-measured tasks (such as fostering critical thinking) (see, e.g., Glewwe, et al., 2003). Educational researchers have questioned the value of incentive programs as well; Murnane and Cohen (1986; cited in Podgursky & Springer, 2008) pose several criticisms of teacher merit pay, and Adams, et al. (2009) call into question whether performance incentives have been as widespread and effective in other sectors as often cited by performance-pay supporters.

With district interest in performance pay growing, and the full implementation of many of the performance pay programs funded by TIF, the evidence regarding performance pay will surely grow over the next several years. That said, given the current scarcity of empirical findings regarding performance pay, as well as pressing demands for knowledge by federal, state, and local districts considering the adoption of performance pay programs (e.g., Honawar, 2009), the

need is evident for research on well-established programs that have been in place for several years.

Methodology

Data and Measures

Achievement analyses were based on panel student and teacher data for the eight school years 2001-02 to 2008-09; data was provided on a rolling basis from Spring, 2006, to present. Data included information regarding school characteristics, teacher experience and demographic characteristics, student achievement and demographic characteristics, and student course-taking with links to individual teachers. Student mathematics and reading scale scores from the Colorado Student Assessment Program (CSAP; Colorado Department of Education, 2009) were modeled as the achievement measure. The CSAP is designed to measure achievement relative to the Colorado K-12 Model Content Standards. It serves as Colorado's state standardized assessment, and is required of all students in grades three through ten. CSAP scale scores have been vertically scaled by the state's contractor; scores range from a minimum of 150 to a maximum of 999. The contractor has established benchmarks to delineate four performance categories specific to each grade; these are labeled "Unsatisfactory", "Partially Proficient", "Proficient", and "Advanced". The district provided data for all students with CSAP scale scores.[2]

Mathematics and Reading achievement effects particular to individual teachers were estimated in two different forms: via *conditional growth percentiles* as well as by *value-added teacher "effects"*[3]. The degree to which variability in each of these effect estimates might be attributable to ProComp was estimated via the general two-step process recommended by Rubin, Stuart, and Zanutto (2004).

Conditional Growth Percentiles

Conditional growth percentiles (CGPs) provide measures of students' academic achievement relative to students with similar CSAP histories. Estimated in a way similar to the "Student Growth Percentiles" of the Colorado Growth Model (Colorado Department of Education, 2010), CGPs represent a student's percentile of CSAP achievement for a given year, relative to achievement of all students in a reference group who share similar prior histories of CSAP achievement. As its name suggests, CGP estimates represent the *percentile* of a given student's achievement among the achievement scores of a reference group.

[2] Students who completed the Spanish-language or alternative versions of the CSAP were excluded from these analyses.

[3]

For example, consider a 4th-grade student whose 3rd-grade CSAP mathematics score was 375. Let's say that student received a score of 420 on the 4th grade mathematics exam. To estimate a CGP for that student, the score of 420 would essentially be compared to all other students with 3rd-grade mathematics scores of 375 (i.e., students who share the same achievement history). If that 420 was higher than 55% of scores of students in this reference group, that student's CGP estimate would be equal to 55. If, on the other hand, a score of 420 was higher than only 35% of the 4th-grade scores of that comparison group, the corresponding CGP estimate would be equal to 35. CGPs, then, provide a measure of *relative* achievement. Students with CGPs near zero underperformed most other students with similar achievement histories; students with CGPs near 100 outperformed most similar students (see Betebenner, 2008, for more details regarding conditional growth estimation in educational accountability contexts).

Like Colorado Growth Model estimates, CGPs in this paper are estimated via quantile regression fit via 4th-order B-splines (Wei & He, 2006)[4]. A couple of key differences differentiate the two, however. First, Colorado's Growth Model uses as a comparison group all Colorado students with valid CSAP scores over the previous five years; the five-year statewide comparison group that changes each year on a rolling basis. CGPs represented here, on the other hand, are estimated relative to all DPS students with valid CSAP scores from 2007 to 2009. Second, reported growth estimates from the Colorado model represent the highest of five different estimates that vary in terms of the number of prior years on which achievement is conditioned. CGPs used in this paper condition on only a single year of prior achievement.

As such, though similar to Colorado Growth Model estimates, CGPs used in this paper are not the same. CGPs here can be interpreted as conditional achievement relative to that of students in 2007 to 2009 who have similar previous-year scores. A 4th-grade in 2005 with an estimated CGP of 45, then, had CSAP achievement that would have exceeded roughly 45% her peers with similar scores had she taken the assessment in 2009. CGPs that exceed 50, then, represent students outscoring similar students in the most recent years of the CSAP. If a majority of CGPs from years prior to 2007 exceed 50, the resulting inference would be that, relative to current achievement, students from previous years had higher achievement. On the other hand, a majority of historical CGPs below 50 would suggest that today's students outperform comparable students from previous years. Though CGPs and estimates from the Colorado Growth Model represent different aspects of conditional achievement, the two estimates are nevertheless highly related. Pearson correlations between the two uniformly exceed 0.90 across math and reading for each of the years 20005-06 to 2008-09.[5]

Teacher level "effect" estimates based on CGPs are represented by the weighted median CGP[6] of all students linked to a given teacher. (This is similar to the criterion for awards under ProComp's "Exceeds Expectations" incentive; receipt of that award is based on whether a

[4] Models were fit using the quantreg and splines packages in the R statistical programming environment (R Development Core Team, 2006)

[5] The Colorado Department of Education has yet to release Colorado Growth Model estimates for years prior to 2005-06.

[6] Weights based on percent of total days each student is enrolled in a teacher's class.

teacher meets a target median student growth percentile based on the Colorado Growth Model.)

Value-added "Effect" Estimates

In addition to CGP-based teacher effect estimates, this study also examined a more common teacher effect estimate based on the multivariate mixed effects model described by Lockwood et al. (2007):

$$\mathbf{Y}_i \left| \boldsymbol{\mu}, \boldsymbol{\theta}, \boldsymbol{\alpha}, \boldsymbol{\Sigma} \sim N_{ST} \left(\mathbf{X}_i \boldsymbol{\mu} + \mathbf{A} \boldsymbol{\Phi}_i \boldsymbol{\theta}, \boldsymbol{\Sigma} \right), \right. \quad (1)$$

$\mathbf{Y}_i$ is a ST vector of CSAP scores for student i, indexed by years (t=1,…,T) within subjects (s=1,…,S); $\mathbf{X}_i$ is an (ST x p) design matrix of student covariates indexed by (subject x year) for the p-dimensional vector of regression coefficients $\boldsymbol{\mu}$. $\boldsymbol{\theta}$ consists of ST effects unique to each teacher (one per subject per year); these are linked to students via $\boldsymbol{\Phi}_i$, and are weighted by persistence parameters $\mathbf{A}$. Equation (1) represents what Lockwood et al. refer to as the "variable persistence model" (2007); the effect θ_{st} associated with a particular teacher is allowed to persist beyond the initial year, though the magnitude of that effect may diminish in subsequent years (the rate of which is parameterized by the α_{tt^*}).[7]

Modeling Achievement on ProComp Participation

Estimated teacher effects generated via both quantile regression (CGPs) and the value-added model represented in (1) were subsequently modeled on ProComp participation. Participation in ProComp was not random; upon implementation, incumbent teachers (those employed at the district as of 12/31/05) could choose whether to opt into the program. To address the potential for selection bias due to the voluntary nature of the reform (for incumbents) we employed a propensity score matching strategy (PSM; Rosenbaum & Rubin, 1983; Rosenbaum, 2002). Matching was carried out on the basis of teacher characteristics, experience, and compensation variables, using via the one-to-one optimal matching algorithm of the matchit package (Ho, et al., 2004; 2007) in the R statistical programming language and environment (R Development Core Team, 2008).

Incumbent teachers were given the opportunity to opt to participate in ProComp at any one of eight windows during the first six years of ProComp; once opted into ProComp, teachers could

[7] A special case of (1) is when $\alpha_{tt^*} \equiv 1$ for all $t \leq t^*$ (i.e., effects persist undiminished in subsequent years); this model is commonly referred to as the "layered" or "complete persistence" model, and is the specification used in the Tennessee Value Added Assessment System (TVAAS; Sanders, Saxton, & Horn, 1997).

not return to the traditional salary system.[8] In a technical sense, then, ProComp is best conceived of as a *dynamic* policy – "treatment" (i.e., ProComp participation) in a given year is conditional on whether one participated in the previous year. To reflect this aspect of ProComp in our analyses we explored the dynamic matching approach described in Abbring & Heckman (2008); because dynamic matching is often thought of as "starving for data" (Lechner, 2008, p. 292), we completed all incumbent ProComp models using more traditional approaches as well.

ProComp Survey Data

Attitudinal analyses were based on responses to ProComp surveys administered to DPS teachers and principals. We surveyed all DPS teachers and principals during Spring, 2009, to measure their attitudes toward ProComp. The teacher survey had a response rate of 53.1 percent, while the principal survey had a response rate of 70.9 percent. Survey results reflect weighting by teacher experience and employment characteristics to account for potential non-response bias.

DPS Aggregate Student Achievement Trends

To properly interpret changes in achievement that may be associated with ProComp, we first detail overall student achievement trends across the district over the years 2002-03 to 2008-09. Table 1 reports mean teacher effect estimates across these years. Distributions of these effects are represented graphically in Figure 1; mean trends are represented in Figure 2.

Table 1. *DPS mean teacher conditional growth percentiles: 2003-2009.*

Year	Reading	Mathematics
2002-03	46.5	48.0
2003-04	43.1	46.0
2004-05	47.2	47.3
2005-06	49.8	50.6
2006-07	47.5	47.4
2007-08	51.4	51.7
2008-09	50.1	50.5

[1]Conditional Growth Percentiles

8 There has been one exception to this rule. As part of contract negotiations ahead of the 2008-09 school year (which resulted in substantial changes to the program), teachers were given a one-time opportunity to opt out of ProComp if they had previously opted in; 43 teachers chose to do so. These teachers are included in analyses prior to 2008-09 and excluded thereafter.

Figure 1. *Distribution of teacher median conditional growth percentiles, 2002-03 to 2008-09.*

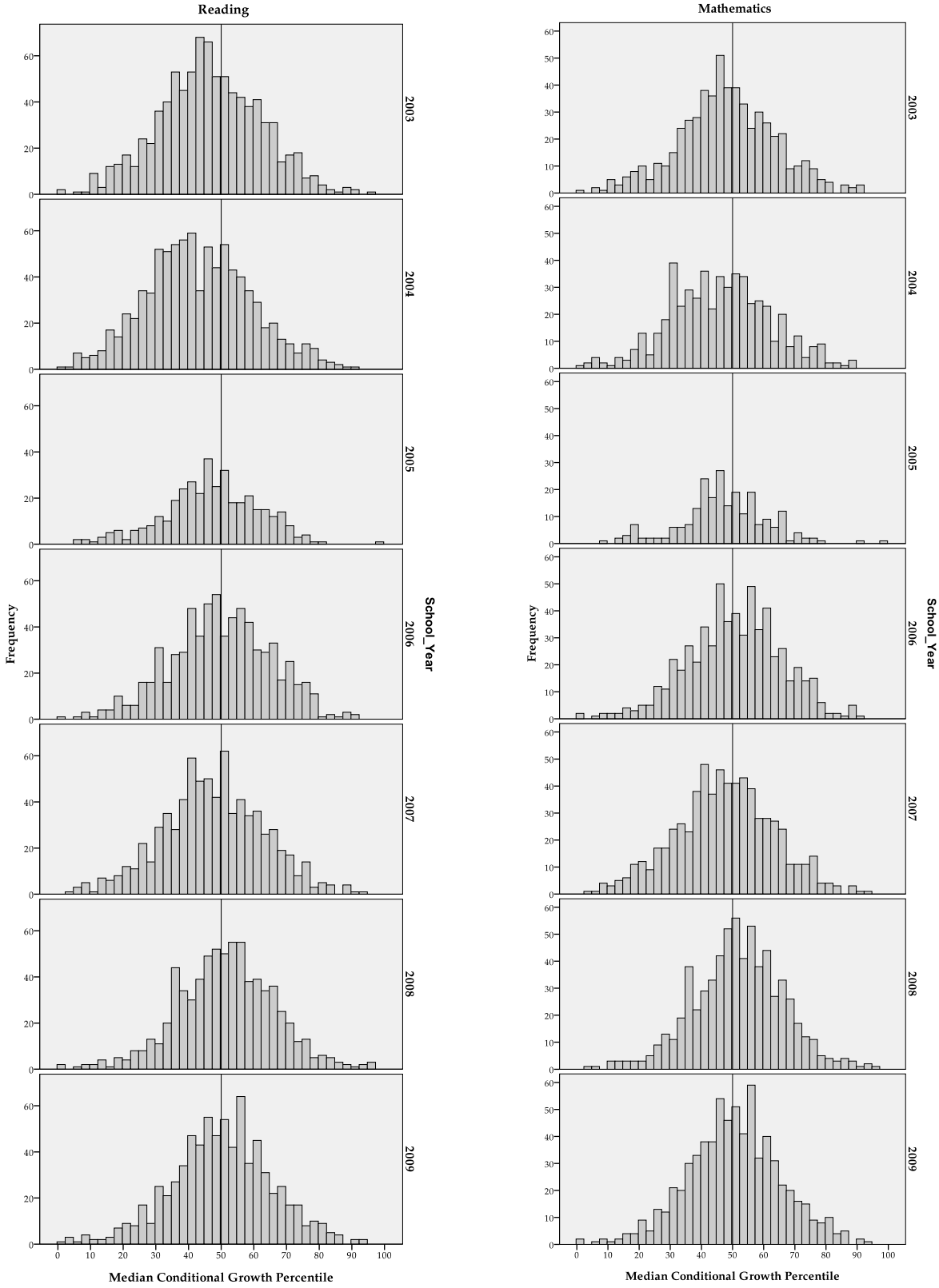
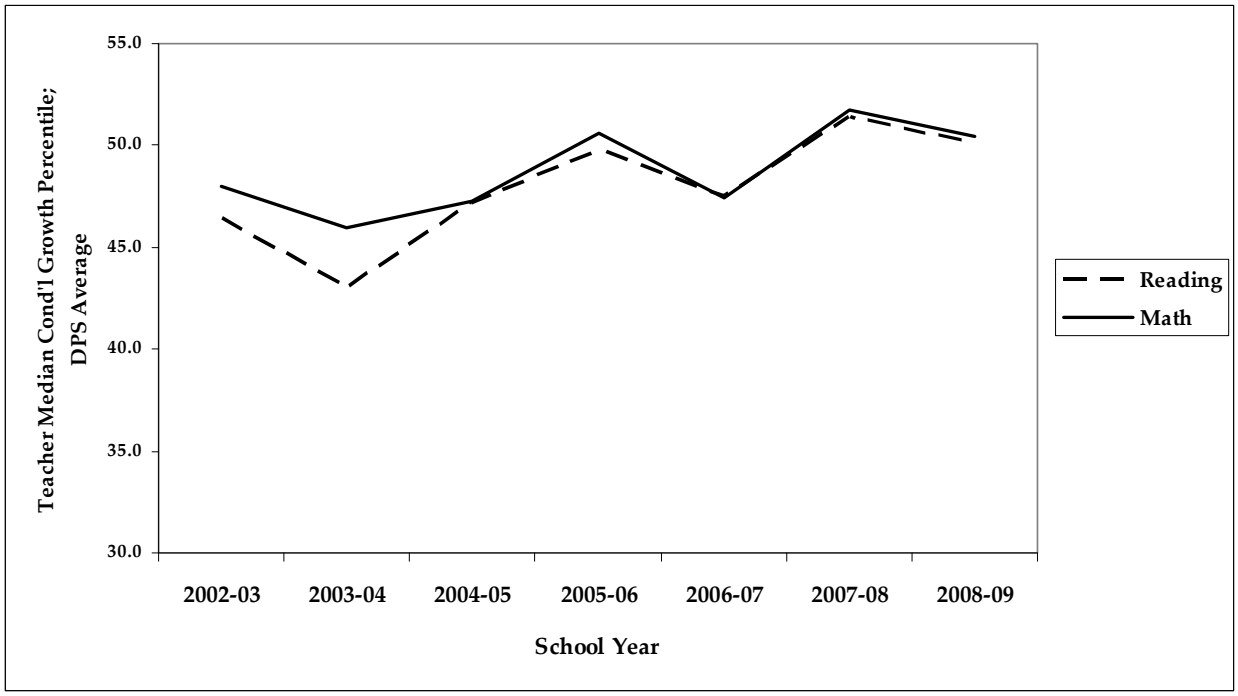


Figure 2. *DPS average teacher median conditional growth percentiles: 2002-03 to 2008-09.*



The tables and figures above detail substantial growth in mathematics and reading achievement from 2002-03 to 2008-09. In particular, district average teacher median conditional growth percentiles have increased 3-8% over the last eight years (Figure 2). Moreover, this result holds across school types, though it's more pronounced at the elementary level. Examination of value-added teacher "effect" estimates exhibited similar trends.

Student Achievement

Incentive-based compensation programs are typically believed to affect student achievement through two channels: (1) by providing motivation for participants to change practice in a way that improves their *productivity*; and (2) by changing the *composition* of the teacher workforce by attracting candidates more likely to be effective; by retaining the most successful teachers; and by facilitating attrition of less successful teachers. Each of these questions is taken up in turn in the sections that follow. Though ProComp is intended to affect *all* participating teachers, the student achievement analyses presented below pertain only to those teachers of math and reading in grades 4 through 10.

Productivity Effects

The idea of an incentive program's "productivity" effect is that the availability of incentives will motivate participants to change their practice in some way that would lead to better outcomes (i.e., greater student achievement). ProComp's inclusion of incentives for knowledge and skill development might enhance likelihood of productivity effects, as teachers may receive added

compensation not only for exceeding achievement expectations, but also for participating in the activities (e.g., completing Professional Development Units; pursuing advanced degrees) more likely to promote such achievements.

The presence of a productivity effect would be signaled by an increase in achievement effects subsequent to introduction of the incentive (and no corresponding increase for those ineligible for the incentive). Figure 3 and Table 2 present mean conditional growth percentiles trends disaggregated by opt-in cohorts (e.g., those coded "Opt-in 2006" switched from the traditional salary schedule to ProComp for the 2005-06 school year).

Figure 3. *Comparison of reading achievement effect trends by opt-in cohort (incumbents as of 1/1/06).*

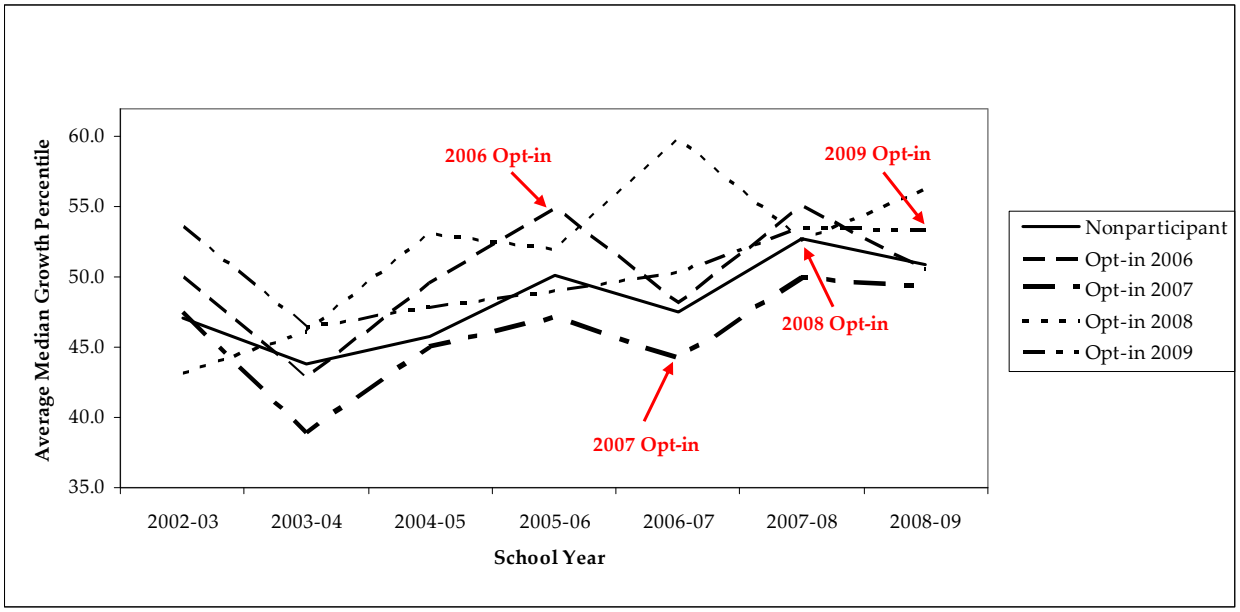


Table 2. *Reading achievement trends for ProComp opt-in cohorts: 2002-03 to 2008-09.*[1]

Year	Non-participant	Opt-in 2006	Opt-in 2007	Opt-in 2008	Opt-in 2009
2002-03	47.1	50.0	47.5	43.2	53.6
2003-04	43.8	42.8	38.9	46.1	46.4
2004-05	45.8	49.6	45.0	53.1	47.8
2005-06	50.1	54.9	47.1	51.9	49.1
2006-07	47.5	48.2	44.2	59.9	50.3
2007-08	52.7	55.1	49.9	52.7	53.5
2008-09	50.9	50.5	49.3	56.3	53.4

1 Underlined figures represent estimates subsequent to opt-in.

The red arrows in Figure 3 identify the point at which each cohort would be expected to begin to exhibit an increase in achievement if, in fact, a ProComp productivity effect was at play; years subsequent to opt-in are also indicated by underlined figures in

Table 2. For example, "Opt-in 2007" teachers first became eligible for incentives in the 2006-07 school year; a productivity effect would suggest that these teachers would have increased achievement effects that year and thereafter. Figure 3 suggests little evidence for productivity effects. Most every ProComp cohort does appear to exhibit increased achievement in the years subsequent to opt-in; however, the same is true for non-participants as well.

Fixed effect estimates from longitudinal mixed effects models of CGPs on opt-in from 2002-03 to 2008-09 are reported in Table 3. Similar patterns are suggested by the two models; in each case (for those teachers incumbent as of 1/1/06):

1. Overall teacher median CGPs were basically flat (at around 45) in the years prior to ProComp implementation in 2005-06

2. Starting during ProComp's implementation year, overall teacher median CGPs increased an average of ~4 points, while the slope of teacher median CGPs increased between 1.25 and 1.5 points.

3. Upon opting into ProComp, participating teachers' CGPs increased roughly another point and the slope of their CGPs decreased around a quarter-point.

Table 3. *Estimates from longitudinal mixed-effects model of Conditional Growth Percentiles on ProComp opt-in*

	Conditional Growth Percentile	
Predictor	Reading	Mathematics
INTERCEPT	44.52	45.48
SCHOOL_YEAR	-0.30	-0.68
POST_PC_IMPLEMENTATION	4.40	3.89
POST_OPTIN	0.87	1.01
POST_PC_IMPLEMENTATION * SCHOOL_YEAR	1.22	1.49
POST_OPTIN * SCHOOL_YEAR	-0.38	-0.28
$R^2_{y,\hat{y}}$	0.027	0.015

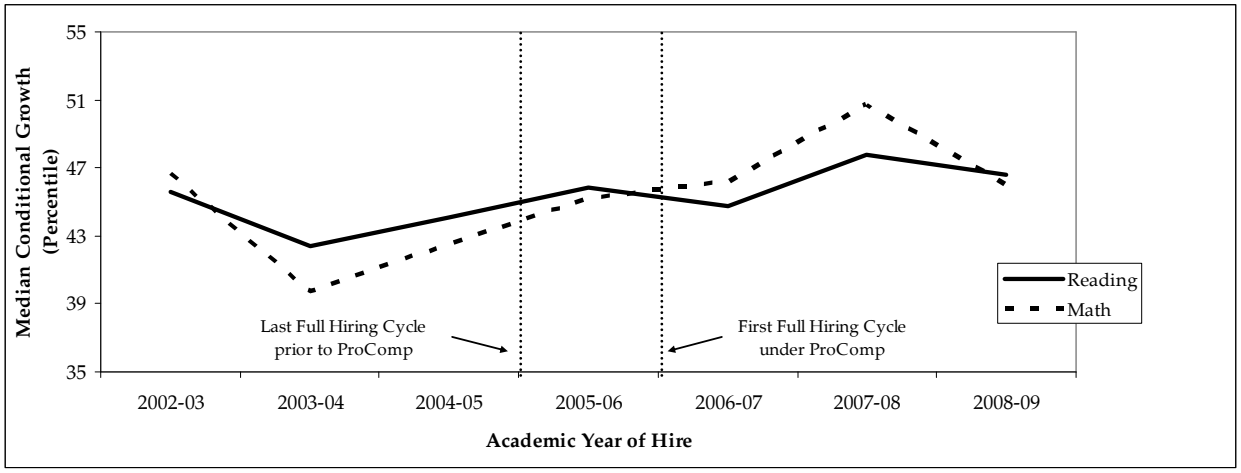
[1] Models included data from the entire population of incumbent teachers whose students completed CSAP assessments; therefore inferential statistics such as test statistics and statistical significance estimates have no clear interpretation. As a consequence they have been omitted from the table above.

These results suggest small positive productivity effects associated with ProComp. That said, neither linear model fits very well; in each case variability accounted for is negligible. (Neither model improved substantially with quadratic, cubic, or ogive models.) Furthermore, when this analysis is repeated using only matched comparison groups, effects associated with ProComp opt-in tend toward zero. Teachers who have voluntarily opted into the ProComp program do appear to have slightly outperformed their non-participant colleagues; whether such differences can be attributed to either a productivity effect of ProComp or the individual differences between teachers choosing to participate and those choosing not to, remains an open question. Furthermore, productivity effects may operate differentially for subsets of the teacher population (e.g., younger, more recently graduated teachers).

Composition/Selection Effects

Incentive programs are believed to have the potential to operate not only by providing incentives for participants to improve their practice, but also by changing the composition of the teacher workforce. Such effects can be gauged by exploring trends in, say, the proportion of new applicants who hold master's degrees or specialized credentials. Figure 4 details trends in first-year achievement effects for teachers joining the district in each of the years 2002-03 to 2008-09.

Figure 4. *First-year achievement of teachers new to DPS (by entry cohort).*



Teachers hired after the implementation of ProComp (subsequent to which program participation has been mandatory) consistently demonstrate higher first-year achievement than those hired prior to the program. Trends represented in Figure 4 suggest 2- to 4-point increases in teacher median CGPs subsequent to ProComp implementation (in addition to a more gradual improvement throughout the entire range under consideration). This pattern is consistent for both mathematics and reading (though more pronounced in mathematics), and it generally

holds across school levels. Furthermore, the results are consistent regardless of whether they are estimated via value-added teacher effects or conditional growth percentiles.

New teachers' three-year achievement trends are presented in Figure 5 and Figure 6 (for reading and mathematics, respectively). Results are less clear for second-year and third-year effects than they are for first-year effects. Teachers joining DPS subsequent to ProComp implementation do outperform those arriving prior to ProComp in their second and third years. However, year-to-year average effects within each of these time periods are substantially variable, preventing a clear inference regarding an effect attributable to the program.

Figure 5. *Teachers' median student conditional growth in initial years after hire: Reading.*

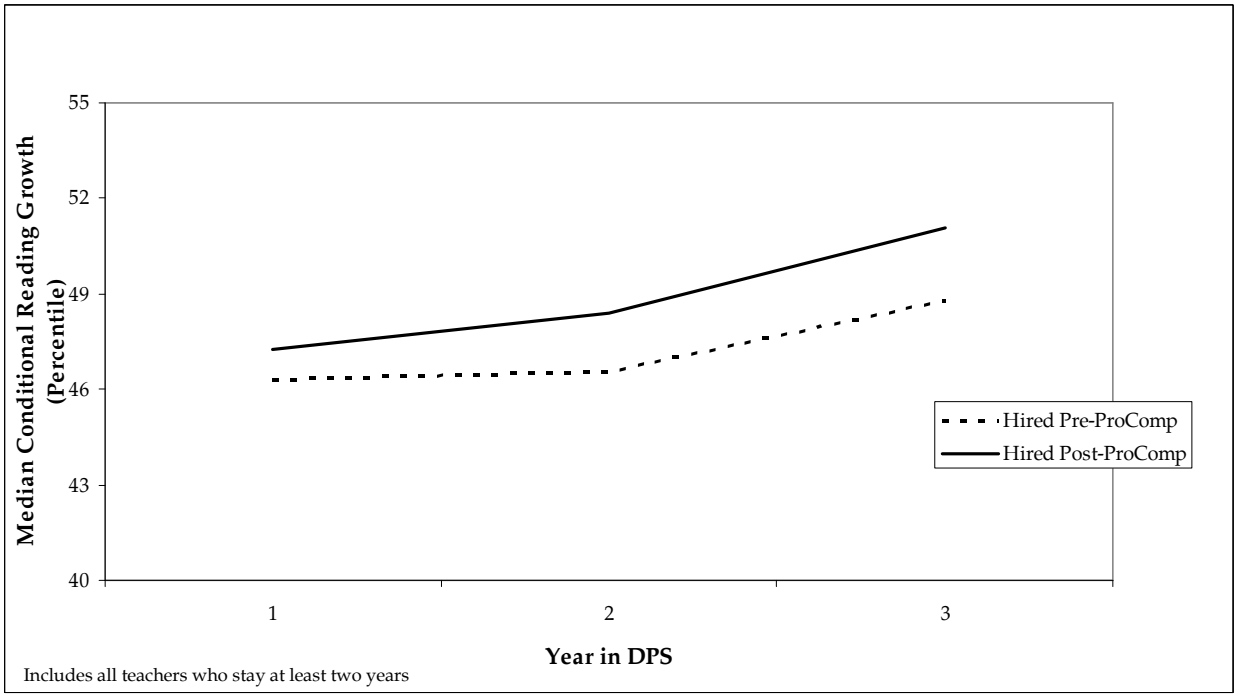
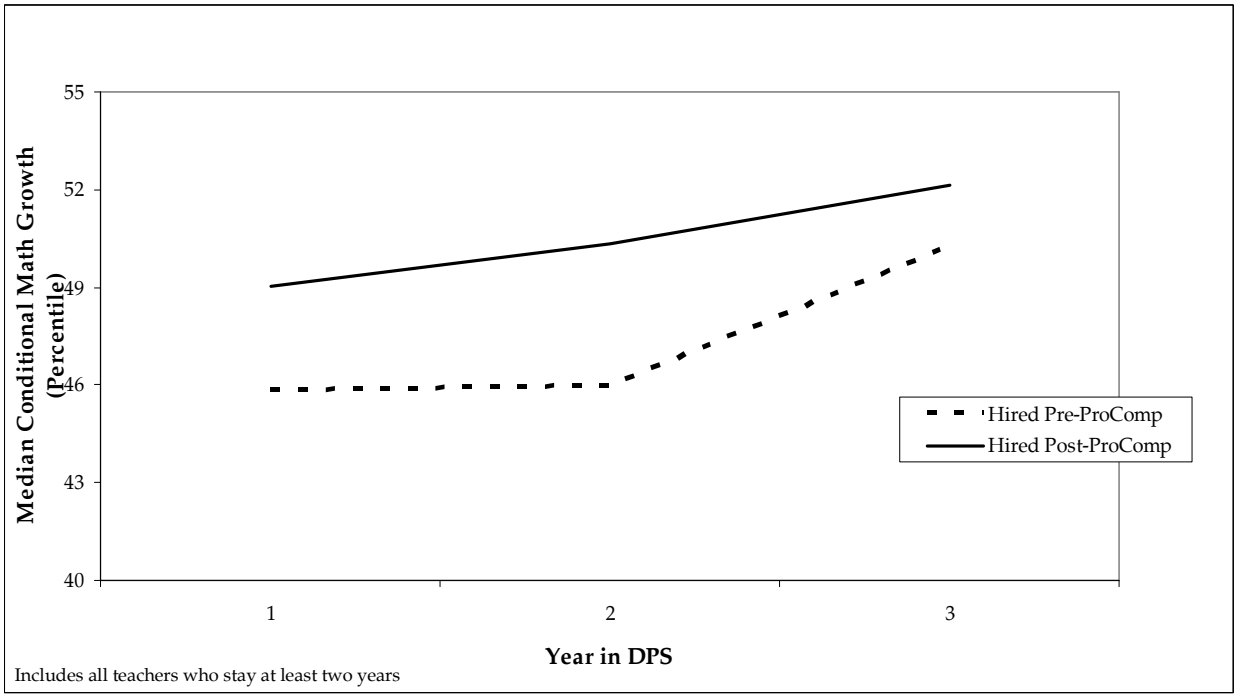


Figure 6. *Teachers' median student conditional growth in initial years after hire: Mathematics.*



Discussion: Student Achievement

Thus far chapter has presented results of analyses that explore the extent to which ProComp participation might be associated with differences in achievement. Teachers of math and reading who were hired after the implementation of ProComp (subsequent to which program participation has been mandatory) do exhibit higher first-year achievement than those hired prior to the program. Moreover, these differences are maintained through teachers' first three years in DPS. Both of these findings are consistent with ProComp *composition effects*, though both may also reflect other policies and contextual factors at play in the years since 2005-06 implementation. Evidence of ProComp *productivity effects* is less clear. Teachers voluntarily participating in ProComp do appear to slightly outperform their non-participant colleagues, and these teachers' achievement effects did appear to increase slightly at the point of opt-in. Differences are mixed when participants are compared to a matched set of non-participating teachers.

Outcomes reported above reflect potential effects at an aggregate (district-wide) level. Analyses have yet to explore either (1) the degree to which program outcomes vary as a function of characteristics of teachers; or (2) the degree to which individual ProComp components variously contribute to ProComp outcomes. These and other questions regarding ProComp outcomes are the subject of ongoing research to be reported in a September, 2010, follow-up to this report.

General Attitudes about ProComp

The survey results that follow have been organized into four sub-sections to best address the research questions that guided this part of the evaluation: 1) General beliefs about ProComp; 2) Beliefs about ProComp relative to the traditional salary schedule; 3) ProComp and student achievement; and 4) and ProComp and instructional behaviors. Within each of these sub-sections we provide an overview of survey responses as well as weighted quantitative results. Teacher survey results, disaggregated by ProComp participation status (i.e., Voluntary, Compulsory, or Not in ProComp) are presented first, followed by principal survey results.

Both the teacher and principal surveys included questions that asked respondents to reflect on their beliefs regarding the effectiveness and appropriateness of ProComp. Table 4 shows teacher survey results disaggregated by ProComp status. Several patterns emerge from Table 4 and foreshadow response trends observed across many survey questions. As expected, teachers who voluntarily entered into ProComp tended to report the most favorable opinions with regard to the effectiveness and appropriateness of the program, while teachers who elected not to participate held the least favorable opinions of the program. Beliefs of new teachers who were automatically enrolled in ProComp tended to fall between the other two groups though were much more similar to the beliefs reported by teachers who had voluntarily joined ProComp. For example, voluntary teachers and compulsory teachers were more than twice as likely (41.2% and 38.0%, respectively) than non-ProComp teachers (19.1%) to strongly agree or agree that ProComp would help DPS attract and retain qualified teachers. The comparable response between voluntary and compulsory teachers is not necessarily expected since the latter group was not given an option to join ProComp. The similarity in their responses may suggest a positive selection effect for new teachers. That is, teachers new to DPS may be selecting the district – at least in part – because they hold favorable opinions about ProComp.

Table 4. *Beliefs of teachers regarding the effectiveness and appropriateness of ProComp.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
ProComp will help DPS attract and retain qualified teachers.					
Voluntary	9.5	30.7	31.0	18.1	10.7
Compulsory	7.2	30.8	32.7	19.2	10.1
Not in ProComp	2.9	16.2	25.0	26.9	28.9
ProComp is aligned with the goals of our district.					
Voluntary	8.6	50.2	32.1	6.1	3.0
Compulsory	6.9	50.8	33.1	5.6	3.6
Not in ProComp	3.5	33.0	37.6	12.5	13.4
I feel more pressure and job stress as a result of ProComp.					
Voluntary	14.9	27.9	24.3	23.1	9.8
Compulsory	16.8	32.8	26.5	15.9	8.0
Not in ProComp	23.7	21.7	33.4	12.2	9.0
ProComp helps create a positive work environment.					
Voluntary	3.9	21.8	41.3	21.0	12.0
Compulsory	3.3	23.6	43.4	21.9	7.7
Not in ProComp	1.8	8.0	32.1	27.3	30.7
ProComp provides a more focused way to think about my work.					
Voluntary	5.3	35.2	29.3	19.4	10.8
Compulsory	5.2	29.9	36.3	18.5	10.1
Not in ProComp	2.2	18.0	24.8	24.7	30.2

The largest percentage of teachers, regardless of ProComp status, tended to agree with the statement that ProComp was aligned with the goals of the district (58.8% of voluntary, 57.7% of compulsory, and 36.5% of non-ProComp participants strongly agreed or agreed). Both voluntary and compulsory participants were evenly divided regarding whether ProComp helped to create a positive work environment; for each group more than 40% responded neutrally, with the balance split nearly evenly between agreement and disagreement. Finally, nearly half of compulsory participants agreed with the statement that they felt more stress and job pressure as a result of ProComp. This is unsurprising given additional stressors faced by new teachers – lack of tenure, less familiarity with curriculum, and fewer established relationships with school and district leadership.

Table 5 presents results from principals' general beliefs about ProComp. Though not all items on the principal survey are identical to those on the teacher survey, those asked on the principal survey are similar in that they attempt to gather information about respondents' beliefs regarding the effectiveness and appropriateness of ProComp. Generally, principals tended to report favorable opinions about ProComp. Results on the four questions asked of both principals and teachers show principals reported more favorable beliefs about ProComp than did teachers. For example, 48.2% of principals, as compared to 39.9% of voluntary teachers and 35.6% of compulsory teachers, strongly agreed or agreed that ProComp provided a more focused way for teachers to think about their work.

Table 5. *Beliefs of principals regarding the effectiveness and appropriateness of ProComp.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
ProComp will ultimately help DPS attract and retain qualified teachers.					
	6.6	42.2	24.7	16.3	2.4
ProComp is aligned with the professional goals of my teachers.					
	4.2	57.2	15.7	13.3	1.8
My teachers feel more pressure and job stress as a result of ProComp.					
	6.0	44.6	17.5	19.3	3.0
I know how to answer my teachers' questions about ProComp.					
	5.4	41.0	24.1	19.3	1.8
ProComp helps create a positive work environment.					
	1.8	23.5	44.6	17.5	4.2
ProComp provides a more focused way for teachers to think about their work.					
	5.4	42.8	24.7	14.5	3.0

Note: Approximately 8% of survey respondents did not respond to these items

Similar to teachers' reported beliefs about ProComp's alignment with the goals of the district (58% of voluntary, 57.1% of compulsory, and 32.9% of non-ProComp teachers strongly agreed or agreed with this statement), most principals (61.4%) also reported favorable beliefs about ProComp's alignment with the professional goals of their teachers.

Overall, voluntary teachers, compulsory teachers, and principals tended to hold more positive beliefs about the general effectiveness and appropriateness of ProComp than negative beliefs. However, these beliefs were rarely reported by a majority of respondents, as a plurality tended to respond to the "Neutral" response option. Nonetheless, more ProComp teachers and principals agreed with positive statements about the effectiveness and appropriateness of ProComp than disagreed.

Attitudes about the Traditional Salary Schedule Relative to ProComp

In addition to asking teachers and principals to report their beliefs about ProComp in general, respondents were also asked to report their beliefs about the traditional salary schedule relative to ProComp. Table 6 through Table 10 present teachers' beliefs about the effectiveness and appropriateness of the traditional salary schedule relative to ProComp. It is important to note that questions about the traditional salary schedule and ProComp were not mutually exclusive; respondents could report favorable or unfavorable beliefs on the same question for both the traditional salary schedule and for ProComp.

Table 6. *Teachers' beliefs about traditional salary schedule.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
Motivate participants to improve instructional practices					
Traditional Salary Schedule					
Voluntary	1.6	16.5	37.9	34.3	9.7
Compulsory	3.4	20.4	38.1	29.8	8.3
Not in ProComp	5.9	28.3	34.9	24.6	6.2
ProComp					
Voluntary	7.1	51.0	24.4	12.0	5.5
Compulsory	7.7	48.3	24.7	12.4	6.9
Not in ProComp	2.9	29.9	25.7	23.6	17.9

As noted above, Table 6 shows teachers who voluntarily joined ProComp tended to report the most favorable beliefs about ProComp (58.1% strongly agreed or agreed) and the least favorable beliefs about the traditional salary schedule (18.1% strongly agreed or agreed) with regard to the ability of each compensation system to motivate participants to improve instructional practices and behaviors. Conversely, non-ProComp teachers reported similar beliefs about the ability of the traditional salary schedule (34.2% strongly agreed or agreed) and about the ability of ProComp (32.8% strongly agreed or agreed) to improve instructional practices and behaviors. Compulsory participants reported beliefs that were between the other groups but most similar to the positive beliefs about ProComp reported by the voluntary teachers.

Readers will notice a similar pattern throughout the following comparative tables. Table 7 shows a comparable pattern to that observed above, however all teachers tended to be less likely to strongly agree or agree that either the traditional salary schedule *or* ProComp would ultimately improve student achievement. That is, teachers reported greater confidence in the potential for either compensation system to improve teachers' instructional practices and behaviors than they did about potential of either compensation system to improve student achievement.

Table 7. *Teachers' beliefs about traditional salary schedule.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
Ultimately improve student achievement					
Traditional Salary Schedule					
Voluntary	1.5	12.9	44.4	32.0	9.2
Compulsory	2.5	15.3	45.3	28.3	8.6
Not in ProComp	5.3	20.1	42.5	23.8	8.3
ProComp					
Voluntary	5.9	40.8	30.3	15.3	7.6
Compulsory	6.3	38.1	31.0	15.9	8.7
Not in ProComp	2.8	19.2	27.6	26.0	24.4

Regardless of ProComp status, Table 8 shows that teachers were more likely to strongly disagree or disagree that the traditional salary schedule improves teacher collaboration in DPS than they were to strongly agree or agree.

Table 8. *Teachers' beliefs about traditional salary schedule.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
Improve teacher collaboration in DPS					
Traditional Salary Schedule					
Voluntary	1.5	12.2	44.4	32.2	9.6
Compulsory	2.8	12.0	47.8	28.8	8.6
Not in ProComp	6.5	15.8	47.0	23.4	7.4
ProComp					
Voluntary	5.3	29.9	33.3	21.8	9.7
Compulsory	5.4	28.7	35.6	20.4	10.0
Not in ProComp	1.8	15.6	28.5	25.7	28.4

Voluntary and compulsory ProComp teachers were more likely to agree that ProComp improves teacher collaboration in DPS, while a majority (54.1%) of non-ProComp teachers disagreed with this statement. Taken together, teachers did not report strong beliefs that either compensation system would improve teacher collaboration in DPS.

Table 9 shows teachers' beliefs about the fairness of the traditional salary schedule relative to ProComp. The starkest contrast between beliefs about fairness of the two compensation systems

was reported by non-ProComp teachers. A majority of non-ProComp teachers (51.6%) strongly agreed or agreed that the traditional salary schedule was fair compared to just 17.3% of teachers who strongly agreed or agreed that ProComp was fair. Though both voluntary and compulsory ProComp teachers agreed ProComp was fair at greater rates than they agreed the traditional salary schedule was fair, the difference was slight (approximately 42% of voluntary ProComp teachers agreed ProComp was fair relative to roughly 35% of voluntary ProComp teachers who reported the traditional salary schedule was fair). Thus it may be that ProComp teachers believe there are certain elements of the traditional salary schedule that are fair (e.g., rewarding teachers for seniority) and certain elements of ProComp that are fair (e.g., rewarding teachers who's students demonstrate high growth on standardized assessments).

Table 9. *Teachers' beliefs about traditional salary schedule.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
Fairness					
Traditional Salary Schedule					
Voluntary	4.6	30.0	32.3	22.4	10.6
Compulsory	5.7	28.3	41.2	17.4	7.4
Not in ProComp	14.3	37.3	26.2	15.6	6.7
ProComp					
Voluntary	5.6	36.6	25.7	19.1	13.0
Compulsory	5.1	38.5	32.8	18.1	5.5
Not in ProComp	2.6	14.7	25.7	27.3	29.7

Table 10 is the final table showing a comparison of teachers' beliefs about the traditional salary schedule relative to ProComp. Though very similar to the question reported in Table 6 (*motivate participants to improve instructional practices*), this question sought to gather information about teachers' beliefs regarding the potential of each compensation system to actually result in improved instructional practices. In nearly every case responses were more supportive of ProComp than the traditional salary schedule; however, fewer teachers were likely to agree that either the traditional salary schedule or ProComp will result in improved instructional practices than they were to agree that either compensation system had the potential to motivate teachers to improve instructional practices.

Table 10. *Teachers' beliefs about traditional salary schedule.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
Financial incentives will lead to improved instructional practices					
Traditional Salary Schedule					
Voluntary	1.1	11.9	40.3	35.0	11.6
Compulsory	3.2	14.3	48.3	24.9	9.3
Not in ProComp	7.0	19.4	40.9	23.6	9.0
ProComp					
Voluntary	6.5	34.2	27.9	17.8	13.6
Compulsory	6.8	35.2	29.3	18.6	10.1
Not in ProComp	3.1	16.7	23.6	24.1	32.5

As we observed previously, principals reported more favorable opinions of ProComp relative to the traditional salary schedule. Table 11 presents results from the principal survey on similar questions comparing beliefs about the traditional salary schedule relative to ProComp.

Table 11. *Beliefs of principals about ProComp relative to traditional salary schedule.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
Motivate participants to improve instructional practices					
Traditional Salary Schedule	0.6	11.4	28.9	42.8	8.4
ProComp	4.8	55.4	18.7	11.4	1.8
Ultimately improve student achievement					
Traditional Salary Schedule	0.6	5.4	39.2	38.0	8.4
ProComp	4.8	56.6	18.7	10.2	1.8
Improve teacher collaboration in DPS					
Traditional Salary Schedule	0.6	8.4	34.3	39.8	9.0
ProComp	2.4	34.3	31.3	20.5	3.0
Fairness					
Traditional Salary Schedule	0.6	21.1	34.9	27.1	7.8
ProComp	2.4	34.9	36.7	12.7	4.2
Aligned with the goals of DPS					
Traditional Salary Schedule	0.6	12.0	31.3	41.0	7.2
ProComp	6.0	62.0	15.7	6.0	1.8

Note: Approximately 8% of survey respondents did not respond to these items.

On the first two questions – motivation to improve instructional practices and ultimately improve student achievement – a majority of principals strongly agree or agree (60.2% and 60.4%, respectively) with regard to ProComp where as only a few (12.0% and 6.0%, respectively) strongly agreed or agreed with regard to the traditional salary schedule. Additionally, a majority of principals (68.0%) strongly agreed or agreed that ProComp is aligned with the goals of DPS, as compared to only 12.6% who strongly agreed or agreed that the traditional salary schedule is aligned to the goals of DPS. Again, we see that the differences between the two compensation systems with regard to improved teacher collaboration within DPS, and even more so with regard to fairness, were relatively small. For example, 37.3% of principals strongly agreed or agreed that ProComp was fair while 21.7% strongly agreed or agreed the traditional salary schedule was fair.

Similar to response patterns about ProComp generally, voluntary teachers, compulsory teachers and principals tended to report more favorable beliefs about the effectiveness and appropriateness of ProComp than about the traditional salary schedule. Conversely, more non-ProComp teachers reported favorable beliefs about the traditional salary schedule than ProComp teachers. These results are unsurprising.

Perhaps more interesting, are the differences in percentages of teachers who strongly agreed or agreed with statements about ProComp. Response patterns about ProComp generally and relative to the traditional salary schedule indicate fewer teachers agreed that ProComp would improve teacher collaboration or help to create a positive work environment. Opponents of alternative teacher compensation plans often highlight the potential for such compensation programs to erode teacher cooperation and result in negative working environments. While both teacher and principal survey results raise this issue, this concern tends to be much more pronounced among *non-participants*, suggesting that this issue could be mitigated as incumbent members of the DPS teacher workforce are gradually replaced by newer members. Nevertheless, ProComp leadership should keep these beliefs in mind in the short term when considering teacher and principal support of ProComp among current DPS educators.

Attitudes Regarding ProComp's Effects on Student Achievement

One of the primary goals of ProComp – and indeed, of most education reforms – is to increase student achievement. Table 12 presents teachers' responses about the potential of ProComp in general to ultimately increase student achievement.

Table 12. *Beliefs of teachers about ProComp and student achievement.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
ProComp can ultimately improve student achievement					
Voluntary	5.9	40.8	30.3	15.3	7.6
Compulsory	6.3	38.1	31.0	15.9	8.7
Not in ProComp	2.8	19.2	27.6	26.0	24.4

More ProComp teachers (46.7% and 44.4%, respectively) strongly agreed or agreed that ProComp can ultimately improve student achievement than disagreed. The pattern was reversed for non-ProComp teachers, a majority (50.4%) of whom disagreed or strongly disagreed with this statement.

Table 13 shows principals' beliefs about the potential of ProComp, in general, to ultimately improve student achievement. A majority of principals (61.4%) strongly agreed or agreed that ProComp could ultimately improve student achievement. Compared with ProComp teachers (46.7% and 44.4%, respectively), principals were much more likely to report beliefs that ProComp could meet the goal of improved student achievement.

Table 13. *Beliefs of principals about ProComp and student achievement.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
ProComp can ultimately improve student achievement.					
	4.8	56.6	18.7	10.2	1.8

Both teacher and principal survey results suggest ProComp teachers and principals do believe ProComp has the potential to ultimately improve student achievement.

Attitudes Regarding ProComp's Effects on Instructional Behaviors

In addition to directly improving student achievement, ProComp may also motivate participants to improve their instructional practices and behaviors which may in turn increase student achievement. To this end, teachers and principals were surveyed about their beliefs regarding the potential of ProComp to motivate participants to improve their instructional practices and behaviors. Table 14 shows teachers' beliefs about the potential of ProComp, in general, to motivate participants to improve their instructional practices and behaviors.

Table 14. *Beliefs of teachers about ProComp and instructional practices.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
ProComp can motivate participants to improve instructional practices.					
Voluntary	7.1	51.0	24.4	12.0	5.5
Compulsory	7.7	48.3	24.7	12.4	6.9
Not in ProComp	2.9	29.9	25.7	23.6	17.9

A majority of ProComp participants (58.1% and 56%) strongly agreed or agreed that ProComp could motivate them to improve their instructional practices. More ProComp participants agreed with the potential of ProComp to motivate participants to improve their instructional practices than agreed with the potential of ProComp to directly improve student achievement. Teachers choosing not to participate in ProComp once again reported skepticism regarding ProComp's potential to motivate participants to improve instructional practices.

Interestingly, principals were actually slightly *less* likely to report that ProComp has the potential to motivate participants to improve their instructional practices and behaviors than they were to report ProComp has the potential to increase student achievement (60.2% as compared to 61.4% strongly agreed or agreed). Table 15 presents results from the principal survey about the potential of ProComp, in general, to motivate participants to improve their instructional practice and behaviors.

Table 15. *Beliefs of principals about ProComp and instructional practice.*

	%Strongly Agree	%Agree	%Neutral	%Disagree	%Strongly Disagree
ProComp can motivate participants to improve instructional practice.					
	4.8	55.4	18.7	11.4	1.8

Discussion: Principal and Teacher Attitudes toward ProComp

Generally, teachers in ProComp and principals hold fairly favorable views of ProComp. Given that teachers not in ProComp have voluntarily chosen to remain in the traditional salary schedule, this is not surprising. Teachers who voluntarily chose to enter into ProComp reported the most supportive attitudes towards ProComp. However, ProComp participants who were required to join based on their hire date also reported relatively positive attitudes about ProComp. This would not necessarily be expected, as these teachers were not given the option of whether to join ProComp. Indeed, this may suggest some positive selection into DPS for new teachers. That is, teachers may be joining DPS because – at least in part – they hold favorable views about ProComp.

More teachers reported beliefs that ProComp had potential to improve teachers' instructional practice and behaviors than that ProComp had potential to directly increase student achievement. Principals were more likely than teachers to report beliefs that ProComp could ultimately increase student achievement.

Finally, teachers and principals tended to indicate much stronger beliefs that ProComp's incentives would improve instructional outcomes and student achievement than would the traditional salary schedule. Not surprisingly, teachers choosing to participate felt much more strongly than did teachers opting to stay on the traditional salary schedule. That this support for ProComp was also common for the two groups of educators for whom participation was *not* voluntary – teachers hired post-2005 and principals – suggests that support for incentive-based compensation may continue to grow with turnover in the DPS educator workforce.

CHAPTER III: Teachers Attitudes, Behaviors, & Student Achievement

Introduction

Alternative teacher compensation programs that seek to improve teacher quality often attach financial incentives to knowledge, skill, and instructional behaviors thought to be associated with improved student learning and achievement, following the assumption that teachers may be more apt to acquire such knowledge and skills and to adopt such practices if financial incentives are attached. Drawing on teacher survey data, this study examines the relationships between teacher attitudes, instructional behaviors, and student achievement. Specifically, we explore the extent to which changes in teachers' instructional behaviors are predicted by their attitudes about alternative teacher compensation plans and prior student achievement gains. We hypothesize teachers who believe in both the efficacy and fairness of an alternative compensation program are more likely to adjust their instructional behaviors to adhere to the goals of that program. Similarly, when measures of student achievement are used to reward teachers, we suspect teachers who previously demonstrated positive gains in student achievement are more likely to embrace such compensation programs. The central question framing our analysis is *to what extent are teachers' beliefs about the efficacy and fairness of Denver's ProComp associated with reported changes in their instructional behaviors, conditioned on prior aggregate student achievement gains?*

In what follows, we first describe our conceptual framework and present the logic model we explored in the study. Additionally, extant literature on teacher attitudes about alternative teacher compensation and teachers' instructional behaviors while participating in an alternative teacher compensation program are reviewed. The next section describes study participants, data sources, measures, and analytic approach employed in the study. Findings are then presented and interpreted in light of our conceptual framework. Lastly, we draw conclusions about the relationship between teacher attitudes, instructional behaviors, and student achievement and discuss several directions we're exploring in ongoing research.

Conceptual Framework & Review of Literature

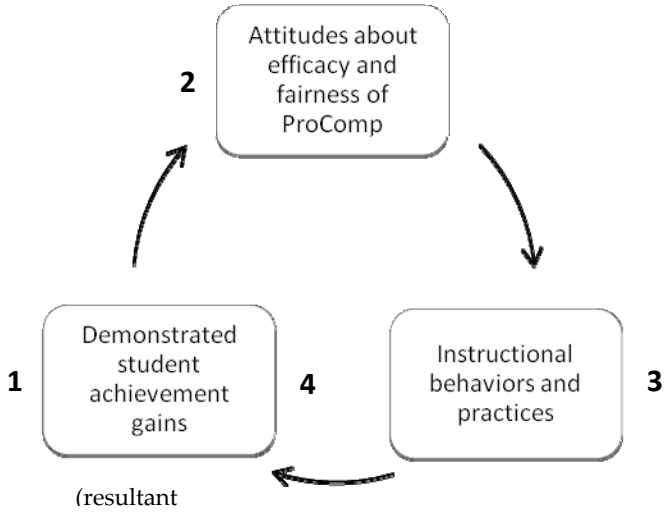
As a strategy to ultimately increase student achievement via higher-quality teachers and improved instructional capacity, the theory of action underlying alternative teacher compensation programs that reward teachers for knowledge, skill, and instructional behaviors is three-fold. This theory holds first that teachers will respond to financial incentives and will alter their behaviors and practices in order to earn them. Second, alternative teacher compensation programs will help attract and retain higher-quality teachers who excel at the activities and tasks attached to incentives. Third, incentives will reinforce a normative vision of quality instruction that supports teacher skill-seeking and efforts to improve instructional behaviors, which in turn contribute to increased student learning and achievement (Milanowski, 2002; Adams et al., 2009).

Conceptual Framework

The conceptual framework developed for this study expands on the first two parts of the theory of action presented above. Considering part one – that teachers respond to incentives by altering their behaviors – we speculate teachers who hold favorable attitudes towards alternative teacher compensation programs are more likely to respond to financial incentives and change their behavior accordingly. It is probable teachers who believe in both the efficacy and fairness of an alternative teacher compensation program would be more likely to buy into the policy and may make greater efforts to adjust their instructional behaviors to adhere to the goals of the program. Similarly, when considering part two of the conceptual framework – alternative compensation programs attract and retain teachers who specifically excel at the activities and tasks attached to incentives – we hypothesize teachers who have previously demonstrated positive student achievement gains are more likely to embrace a compensation program that either rewards teachers directly for improved student achievement or indirectly for obtaining knowledge and skills thought to be associated with improved student achievement. Finally, if rewarding teachers for knowledge, skill, and instructional behaviors thought to influence student achievement can succeed in improving teacher quality and ultimately student achievement, as the third piece of the conceptual framework posits, we also expect there to be a relationship between teachers' instructional behaviors and subsequent student achievement gains.

Taken together, we posit teacher attitudes, instructional behaviors, and student achievement have a cyclical relationship. Figure 7 presents the logic model created to further explain these hypothesized relationships. Developed to conceptualize the relationships between attitudes, behaviors, and student achievement for a given teacher in a single year, the logic model begins with a consideration of a given teachers' demonstrated student achievement gains in the year prior to the year under consideration (1). Again, we hypothesize improved gains in achievement may positively influence teachers' attitudes about alternative teacher compensation plans that include rewards for improved student achievement. These attitudes (2) may in turn influence the likelihood that a teacher will adjust his or her instructional behaviors and practices to align more directly with the goal of improving student achievement; presumably, teachers who believe in the efficacy and fairness of an alternative teacher compensation program would be more likely to adjust their behaviors to adhere to the goals of the program (3). Lastly, we theorize teachers who gain knowledge and skill, and who implement instructional behaviors and practices associated with improved student achievement, are likely to demonstrate greater student achievement as a result of instructional behaviors and practices (4). The findings presented in this chapter are designed to explore these hypothesized relationships.

Figure 7. *Logic model of relationships between teacher attitudes, behaviors, and student achievement.*



Review of Literature

In order to gain an understanding of the way in which teacher attitudes and prior student achievement influence instructional behaviors and practices within the context of an alternative teacher compensation program, we reviewed the relevant extant literature. This review drew primarily from empirical studies of alternative teacher compensation programs, many of which also relied on teacher survey data. Although much research has been conducted on teacher attitudes about alternative teacher compensation during recent decades, results remain ambiguous and inconsistent (Ballou & Podgursky, 1993; Goldhaber, DeArmond, & DeBurgomaster, 2007; Jacob & Springer, 2008). Jacob and Springer argue such inconsistencies have resulted from several factors: different descriptions and formats of alternative teacher compensation programs referenced hypothetically or specifically; various degrees of rigor attributed to the research and survey methodology utilized for exploring teacher attitudes; and, systematic differences in respondents (e.g., gender, race, geographic location, academic background, and local school context).

Our review of the extant literature found no research that directly examines the influence of previously demonstrated student achievement gains on teacher attitudes about alternative teacher compensation plans. However, the literature does suggest teachers' attitudes towards alternative teacher compensation programs are generally less favorable when incentives are linked exclusively to student achievement. For example, in their study of alternative teacher compensation in Florida, Jacob and Springer (2008) found only 35% of respondents supported the use of standardized student assessments to provide teachers with financial rewards. Findings from a study of the Teacher Advancement Program (TAP) in South Carolina suggested only 18% of respondents supported linking standardized student assessments to teacher compensation (Agam, Reifsneider, & Wardell, 2008).

Although studies that have examined changes in teachers' instructional behaviors within the context of an alternative teacher compensation program exist, results are mixed. In their study

of South Carolina's TAP, Agam, Reifsneider, and Wardell (2008) found 74% of teachers reported they altered their teaching after receiving feedback from mentor teachers who evaluated their teaching style. Conversely, 73% of teachers surveyed in Texas claimed their participation in the Governor's Educator Excellence Grants (GEEG) program *did not* change their teaching behaviors (Springer et al., 2009). Barnett et al. (2007) also find little evidence to suggest teacher participation in the Achievement Challenge Pilot Project (ACPP) in Little Rock, Arkansas resulted in changes to teachers' instructional behaviors.

In their study of alternative teacher compensation in Florida, Jacob and Springer (2008) found evidence to suggest both teachers' attitudes towards alternative teacher compensation and their instructional behaviors appeared to be related to teachers' self-efficacy. Teachers who believed they could create positive change and impact their students were more likely to support alternative teacher compensation programs. Additionally, teachers were more likely to report changes in their instructional behaviors if they possessed high levels of self-efficacy.

The majority of research examining teachers' attitudes about alternative teacher compensation is detached from any exploration of subsequent changes in teachers' instructional behaviors. Furthermore, our review yielded no extant research on the relationship between teacher attitudes and instructional behaviors that also considered the influence of prior student achievement gains. This study seeks to mitigate this gap in the research; findings should be of interest to researchers, policy makers, teachers, and parents.

Methodology

We gathered quantitative data via a teacher survey administered to DPS teachers in May, 2009 (and described in Chapter 2). All DPS teachers eligible to participate in ProComp received the survey; 53.1% responded.

Participants

Although the survey was administered to all teachers, these analyses explore reported changes in teachers' instructional behaviors. As such, the sample of teachers was restricted to include only ProComp participants (N=1,973). Table 16 describes the characteristics of our sample. Although the sample was spread fairly evenly among teachers who voluntarily entered ProComp and those who were required to enter because of their hire date, respondents were more likely to be White (non-Latino) and female. Additionally, respondents were more likely to be tenured, elementary/K-8 school teachers, who had attained a Master's degree or other advanced degree.

Table 16. *Demographic characteristics of respondents.*

Demographic characteristic	Percentage
ProComp entry type	
Voluntary	51.7
Compulsory	48.3
Gender	
Female	80.0
Male	20.0
School type	
Elementary/K-8	53.3
Secondary	34.9
Other	11.8
Educational attainment	
Bachelor's Degree	41.9
Master's and above	58.1
Seniority	
No tenure	36.4
Tenured	63.6
Race/Ethnicity	
White, not Latino	79.0
Minority	21.0

This sample is further reduced for analyses that rely on previously demonstrated achievement gains: Achievement data is available only for teachers of tested subjects (reading, writing, and math) and grades (grades 4-10). Additionally, in order to estimate growth in the year prior to survey administration (2008), teachers must have also been employed in the district in 2007-2008. Thus, achievement analyses are estimated from a significantly constrained sample (N=191). However, despite the smaller sample, the distribution across the demographic characteristics presented in Table 16 is similar.

Data Sources

The study draws on two primary data sources: 2009 teacher survey data and 2008 aggregated student growth percentile values generated via the Colorado Growth Model[9]. The 2009 survey data included items about teachers' attitudes about ProComp as well as changes they had made in their instructional behaviors as a result of participating in ProComp. Items were formatted using a Likert scale in which respondents were asked to rate the extent to which they agreed with a given statement. Scaled response options included:

- Strongly Agree
- Agree
- Neutral
- Disagree
- Strongly Disagree
- Not Applicable

Skip patterns were used throughout the survey to ensure respondents received only relevant items specific to their ProComp status, successful completion or earning of ProComp incentives, and position/school location. For example, only ProComp participants received items that asked the extent to which ProComp had led them to change their instructional behaviors.

The 2008 student growth percentile data was gathered from DPS and generated by the Colorado Department of Education, using the Colorado Growth Model. The Colorado Growth Model (CGM) provides a normative measure of change in student achievement over time that relies on a quantile regression model. Student growth percentiles provide an estimate of student growth relative to students with similar score histories. By aggregating individual student growth percentiles to teachers, we are able to identify teachers whose students appear to make low, average, or high growth from one year to the next. DPS awards the "Exceeds Expectations" incentive to teachers who have at least 50% of their students attain student growth at the 55th percentile or higher.

Measures

The 2009 teacher survey included questions on (a) changes in instructional behaviors, and (b) attitudes about the efficacy and fairness of ProComp. To understand changes in instructional behaviors, respondents were asked to report how ProComp has led them to:

1. change the content of what [they] teach.
2. change the way [they] teach (e.g. by using different teaching methods).
3. focus [their] teaching more on raising student achievement.

[9] Ideally, we would have also included 2009 aggregated student growth percentile data in this analysis; however, these data are currently unavailable.

To ascertain attitudes about the efficacy and fairness of ProComp, teachers were asked to indicate the extent to which they agree to each of the following:

1. ProComp can motivate participants to improve instructional practices.
2. ProComp can ultimately improve student achievement.
3. ProComp will help DPS attract and retain qualified teachers.
4. ProComp is aligned with the goals of our school district.
5. ProComp is aligned with my goals as an educator.
6. ProComp is a fair program.
7. The financial incentives in ProComp will lead to improved instructional practice.
8. ProComp provides me with a more focused way to think about my work.

Preliminary analyses suggested responses to the above "behavioral change" items were strongly correlated. Similarly, responses to "attitudinal" items were also strongly correlated (see Appendix C and Appendix D for respective item correlations). Prompted by these strong correlations, we performed exploratory factor analysis. Using principal components extraction, we created two standard normal composite scores: BEHAVIOR and ATTITUDE (see Appendix E and Appendix F). Although not the primary focus of the study, it is interesting to note behavioral change items and attitudinal items each loaded strongly onto a single factor that explained the majority of the variation in responses to these two item strands (81.1% and 66.5%, respectively). This suggests respondents who are amendable to changing their instructional behaviors were likely to report doing so in multiple ways. Similarly, the nature of respondents' attitudes about the efficacy and fairness of ProComp was fairly consistent across a variety of items. That is, respondents with positive views of ProComp generally tended to respond positively across all attitudinal items while respondents with negative views of ProComp generally tended to respond negatively across all attitudinal items.

Analytic Approach

Our exploration of reported changes in teachers' instructional behaviors under ProComp was divided into two methodological strands. First, we compiled basic descriptive statistics that focused specifically on the distribution of responses on aforementioned behavioral change items and attitudinal items. Second, we modeled reported changes in instructional behaviors on reported attitudes of the efficacy and fairness of ProComp, opt-in status, and two different prior student achievement gains predictors. In this strand we employed multiple regression to determine, among the data available, whether attitudes and previously demonstrated student achievement gains influenced reported changes in teachers' instructional behaviors.

Findings

In the section that follows, we first present findings from our descriptive analysis of the distribution of responses on behavioral changes and attitudes and then present findings from statistical models of changes in instructional behavior.

Descriptive Analysis

Across all behavioral change questions and most attitudinal questions, teachers who entered into ProComp voluntarily were slightly more likely to strongly agree or agree with item stems. Table 17 presents response distributions for the behavioral change items. Teachers were most likely to agree that participating in ProComp had led them to focus their teaching more on raising student achievement (45.8% of voluntary teachers agreed or strongly agreed and 41.7% of compulsory teachers agreed or strongly agreed) and least likely to agree that participating in ProComp had led them to change the content of what they teach (just 18.2% of voluntary teachers agreed or strongly agreed while just 14.2% of compulsory teachers agreed or strongly agreed).

Table 17. *Influence of ProComp to change teacher behavior.*

	%Strongly Disagree	%Disagree	%Neutral	%Agree	%Strongly Agree	%NA
Change the content of what I teach.						
Voluntary	22.7	26.7	27.7	15.0	3.2	4.6
Compulsory	25.1	24.0	29.3	11.7	2.5	7.4
Change the way I teach (e.g. by using different teaching methods).						
Voluntary	18.4	22.2	24.6	26.3	5.1	3.4
Compulsory	20.1	20.4	26.2	23.0	4.3	6.1
Focus my teaching more on raising student achievement.						
Voluntary	15.2	15.4	20.5	33.6	12.2	3.1
Compulsory	15.6	14.4	23.1	31.8	9.9	5.1

Such trends in the response distribution are not surprising as most teachers have limited control over the content they teach and greater flexibility with regard to the delivery of the content (the way they teach), and the emphasis placed on increasing student achievement. Again, these responses were combined into a standard normal composite score: BEHAVIOR for the statistical modeling purposes.

Response distributions across attitudinal items are presented in Table 18.

Table 18. *Teacher attitudes toward ProComp.*

	%Strongly Disagree	%Disagree	%Neutral	%Agree	%Strongly Agree
ProComp can motivate participants to improve instructional practices.					
Voluntary	5.5	12.1	24.0	51.0	7.3
Compulsory	7.1	12.2	24.2	48.9	7.5
ProComp can ultimately improve student achievement.					
Voluntary	7.9	15.2	29.9	40.8	6.3
Compulsory	9.0	15.1	30.9	38.7	6.4
ProComp will help DPS attract and retain qualified teachers.					
Voluntary	10.9	17.9	30.5	31.2	9.5
Compulsory	11.1	19.2	31.5	30.6	7.6
ProComp will improve teacher collaboration in DPS.					
Voluntary	9.7	21.5	33.1	30.1	5.5
Compulsory	10.6	20.1	35.0	29.0	5.4
ProComp is aligned with the goals of our school district.					
Voluntary	3.3	6.2	31.1	50.7	8.7
Compulsory	3.7	6.0	33.0	49.9	7.4
ProComp is aligned with my goals as an educator.					
Voluntary	6.4	9.8	25.1	48.2	10.5
Compulsory	6.8	10.2	27.6	44.9	10.5
I feel more pressure and job stress as a result of ProComp.					
Voluntary	9.8	23.0	25.0	27.4	14.8
Compulsory	8.6	15.8	26.1	31.7	17.8
ProComp is a fair program.					
Voluntary	12.8	19.2	25.5	36.4	6.1
Compulsory	6.4	17.7	32.2	38.2	5.4
ProComp helps to create a positive work environment.					
Voluntary	11.6	21.3	40.7	22.2	4.1
Compulsory	8.7	21.4	43.3	22.8	3.8
The financial incentives in ProComp will lead to improved instructional practice.					
Voluntary	13.4	17.9	27.2	34.7	6.8
Compulsory	10.9	18.2	29.0	34.6	7.2
ProComp provides a more focused way to think about my work.					
Voluntary	10.8	19.4	28.7	35.4	5.7
Compulsory	10.5	17.9	35.7	30.8	5.2

Again, teachers who entered into ProComp voluntarily tended to report slightly more favorable attitudes about the efficacy and fairness of ProComp than did teachers who were required to join. Importantly, a majority of ProComp teachers – regardless of the way in which they entered ProComp – reported ProComp *could motivate* participants to improve instructional practices (58.3% and 56.4%). However, slightly fewer teachers agreed or strongly agreed that ProComp *would lead* to improve instructional practices (41.5% and 41.8%). In general, teachers were most likely to report that ProComp was aligned to the goals of the district and their goals as educators and least likely to report that ProComp helps to create a positive work environment. As with behavioral change items, attitudinal items were combined into a standard normal composite score: ATTITUDE for statistical modeling purposes.

Statistical Model of Reported Changes in Instructional Behaviors

We modeled reported changes in instructional behavior via multiple regression. Independent variables included a composite score of attitudes about the efficacy and fairness of ProComp, the percentage of students with growth percentiles that were above the 55th percentile in the previous year, whether Exceeds Expectations for reading or math was earned in the previous year, and opt-in status. Appendix G presents the full results from three different model specifications. The final model, employing independent variables *ATTITUDE* and *EE* (separately for math and reading), constitutes a significant improvement in explanatory power over any other model tested. Inclusion of the percentage of students with growth percentiles that were above the 55th percentile, opt-in status, and interactions were not statistically significant and did not significantly improve explanatory power. Thus, these were not included in the final model.

The final model also added predictive power as compared to the constant-only model, though the total variance explained in reported changes in instructional behavior remained relatively small ($R^2 = .278$). Ultimately, the formal model of reported changes in instructional behaviors was specified as follows:

$$BEHAVIOR_i = \alpha + \beta ATTITUDE_i + \pi EE_{is} + \varepsilon_{is}$$

where the outcome *BEHAVIOR* is the composite reported change in instructional behaviors; α is the mean reported change in instructional behaviors for all individuals in the sample; *ATTITUDE* is the composite score of attitudes towards ProComp for individual *i*; *EE* is a binary indicator of earning the 2008 Exceeds Expectations incentive for individual *i* in subject *s* (an acknowledgement by the district of effective teaching) that takes on a value of 1 for teachers who earned the Exceeds Expectations award in 2008 and a 0 otherwise; and ε is the residual error term.

The final model was specified such that reported changes in instructional behaviors are a function of mean reported changes in behaviors (α, the constant), teachers' attitudes about the efficacy and fairness of ProComp (β), whether teachers' earned the Exceeds Expectations

incentive in either math or reading (π), and the idiosyncratic error (ε). In this study, β is the key parameter of interest.

Table 19 presents estimates associated with the independent variables included in the final model. Estimates in Table 19 are for reading Exceeds Expectations only; estimates for math Exceeds Expectations can be found in Appendix G.[10]

Table 19. *Estimates for selected linear model (reading).*

Parameter Estimates	β	Standard Error	t	Significance
Intercept	.118	.107	1.099	.274
ATTITUDES	.453	.071	6.373	.000
EE_READ	-.291	.146	-1.993	.049

$R^2 = .278$

As Table 20 illustrates, attitudes exert a powerful positive influence on reported changes in instructional behaviors. Recalling that both the outcome variable and independent variable of interest are standard normal composite scores, we can interpret parameter estimates from the final model as changes in standard deviations. Thus, estimates suggest reported changes in instructional behaviors are associated with an increase .453 standard deviations for every one standard deviation increase in attitudes. This estimate is both statistically significant and practically significant as it suggests every standard deviation increase in attitudes is associated with an increase of roughly half a standard deviation on reported behavioral changes. Substantively, this estimate suggests there is an association between attitudes about ProComp and changes in instructional behaviors as a result of ProComp, which supports our hypothesis about the positive relationship between attitudes and reported changes in instructional behaviors.

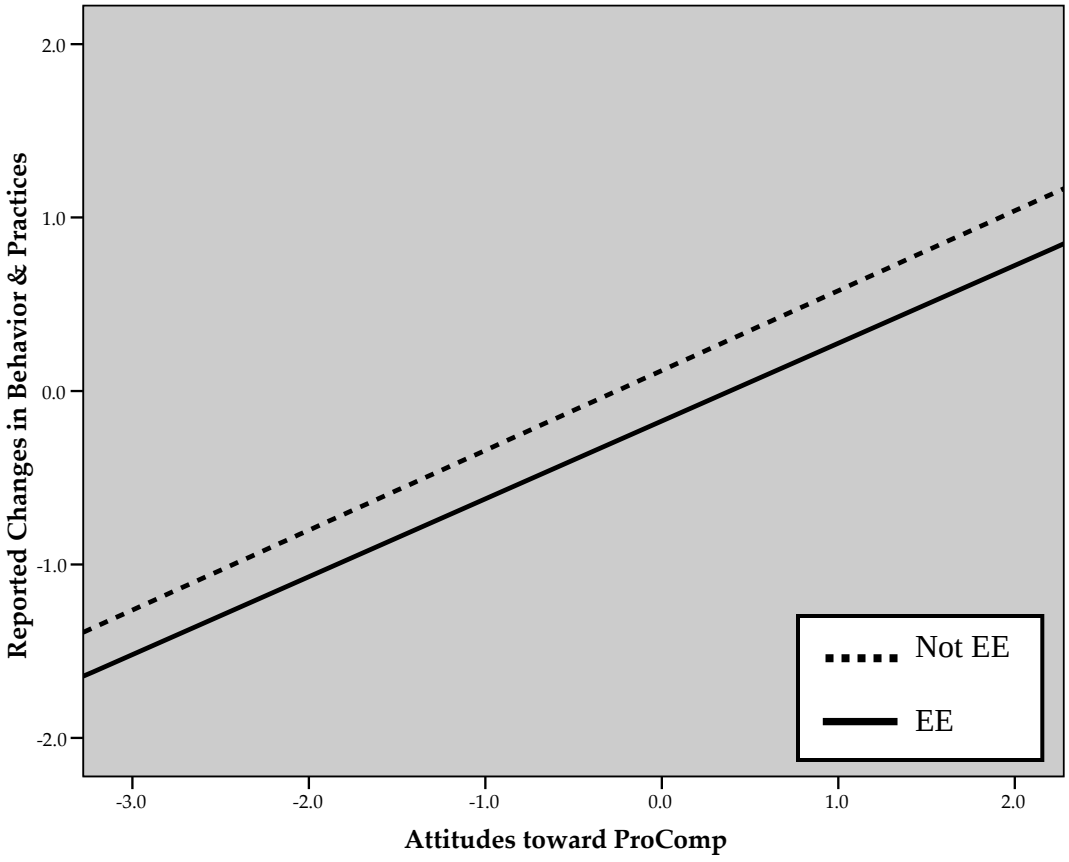
Estimates presented in Table 19 also suggest earning the 2008 Exceeds Expectations incentive in reading has a negative relationship with reported changes in instructional behaviors. Teachers who earned the 2008 Exceeds Expectations incentive in reading were .3 standard deviations lower than those who did not earn the incentive on reported changes in instructional behaviors. This suggests teachers who have been formally acknowledged by the district as successful teachers may be less likely to report they have changed their instructional behaviors as a result of participating in ProComp. Although this effect is in the opposite direction that we hypothesized, this seems reasonable; teachers who have earned the Exceeds Expectations incentive may conclude they are successful teachers using their current instructional behaviors

[10] Estimates for earning the 2008 Exceeds Expectations incentive for reading were more significant than estimates for math, though estimates for both subjects were consistent in direction and magnitude. This suggests that although earning Exceeds Expectations in math was not statistically significant, it may have a practically significant effect on teachers' reported changes of instructional behaviors.

and thus, have little impetus to change.

Figure 8 illustrates the relationships between reported changes in instructional behavior, attitudes, and reading Exceeds Expectations.

Figure 8. *Prototypical plot for selected linear model (reading).*



In Figure 8, the positive relationship between attitudes and reported changes in teachers' instructional behaviors is obvious. Additionally, teachers who *did not* receive the 2008 reading Exceeds Expectations incentive are marginally more likely to report changes in their instructional behaviors than teachers who received the incentive. Again, this suggests teachers with formal acknowledgement from the district of successful teaching have little reason to change their instructional behaviors.

Discussion

This analysis examined relationships between teachers' attitudes, instructional behaviors, and demonstrated student achievement within the context of ProComp. As we hypothesized, teachers who reported favorable attitudes towards ProComp were more likely to report they had changed their instructional behavior. Interestingly, conditioning attitudes on a continuous measure of student growth – the *percentage* of students with student growth percentiles above the 55th percentile – had *no effect* on teachers' reported changes in their instructional behaviors. Conditioning attitudes on whether teachers had be acknowledged by the district as effective teachers by earning the Exceeds Expectations incentive, however, had a negative effect on reported changes in teachers' instructional behaviors. This was true for teachers who earned the Exceeds Expectations incentive in both reading and math, though estimates of the effect of reading were more significant. We found this somewhat surprising as one might expect to observe a larger effect on reported changes in teachers' instructional behaviors when conditioning on the continuous measure of student growth than on the dichotomous distinction of earning the Exceeds Expectation incentive. Given this was not the case, we suspect prior student achievement gains specifically linked to district recognition may be more influential on reported changes in teachers' instructional behaviors.

We plan to pursue additional analyses to better understand the relationship between attitudes, behaviors, and student achievement. As data become available indicating recipients of the 2009 Exceeds Expectations incentive, we plan to explore whether we can predict receipt of the incentive on reported changes in instructional behaviors. Additionally, it will be interesting to model changes in the percent of students above the 55th percentile in 2008 and in 2009 to determine whether changes in student achievement gains are predicted by reported changes in teachers' instructional behaviors. Such an exploration will inform relationship 4 in our logic model and provide insight as to whether teachers who earn the Exceeds Expectations incentive and have varying changes in the percentage of students with growth percentiles above the 55th percentile can be predicted by reported changes in their instructional behaviors.

Findings presented herein provide preliminary evidence to support the theory of action underlying alternative teacher compensation programs that attach incentives to knowledge, skill, and instructional behaviors. Additional research will further our understanding of the relationships between attitudes, instructional behaviors, and student achievement and inform the theory of action underlying such alternative teacher compensation programs.

CHAPTER IV: ProComp and Retention in Hard-to-Serve Schools

Introduction

Can financial incentives mitigate teacher turnover at impoverished schools? This chapter explores this question by examining the effects of a financial bonus offered to teachers who work in hard-to-serve schools[11] on teachers' employment patterns. Given the persistent pattern of teacher turnover at hard-to-serve (HTS) schools, state and federal policy makers, district officials, and researchers alike are scrambling for ways to increase teacher retention at impoverished schools. Findings from this study will contribute to the small body of research about teachers' responses to market-based financial incentives and, more broadly, to the body of research about teacher employment patterns.

The HTS bonus is one of ten elements in Denver's ProComp that offers a monthly financial bonus to teachers employed at HTS schools. Since ProComp is an established, well-funded, and comprehensive alternative teacher compensation reform, it has all the pieces in place and accordingly provides a unique context in which to explore the effect of a financial bonus on teacher employment decisions. If financial bonuses help to keep teachers at HTS schools, we would expect to see evidence of this under ProComp.

Recent survey data[12] from DPS teachers and principals suggests rewards for educators who teach at HTS schools are widely supported. Nevertheless, data from the 2007 and 2008 surveys suggest teachers who were employed at HTS schools report the initial HTS bonus (2006-07 and 2007-08) did little to encourage them to remain at those schools. Conversely, data from the survey administered after changes were made to the HTS bonus (2008-09) suggest more ProComp teachers who work at HTS schools are encouraged to remain in their schools because of the HTS bonus.

These findings are difficult to put into the context of extant research because, despite the increased prevalence of financial incentives to attract and retain teachers to work at HTS schools, there is little evaluative research to date on the effects financial incentives have on teacher employment patterns (Holley, Barnett, & Ritter, 2007; Jacobson, 2006). At best, evidence about whether financial bonuses can help retain teachers at impoverished schools is mixed (Jacobson, 2006). In fact, recent studies using teacher survey data suggest teachers prioritize many factors when making employment decisions and money is often *not* a high priority for them when making decisions about where to work (Buckley, Schneider, & Shang, 2004;

[11] "Hard-to-serve" schools are those that serve the most high-poverty student populations in the district.

[12] In 2007, 2008, and 2009 DPS teachers and principals were surveyed regarding their attitudes and beliefs about ProComp and the HTS element specifically. Response rates were high, with approximately 55% of teachers responding in 2007, 52% of teachers responding in 2008, and 53% of teachers responding in 2009. Principal response rates were approximately 80% for all three years the survey was administered.

Hanushek, Kain, & Rivkin, 1999; Johnson, Berg, & Donaldson, 2005; Kirby & Grissmer, 1993; Milanowski, et al., 2007).

In the most general sense, this study seeks to better understand the effects of a financial bonus on teacher retention four years after the implementation of ProComp. The central research question guiding this study is: *Does the HTS bonus offered under ProComp alter current trends of teacher retention in HTS schools?* Understanding whether and how financial incentives increase teacher retention at impoverished schools is imperative to increasing access to a high quality education for all students. The effect of financial incentives on HTS schools in Denver can inform strategic policy at the local, state, and federal levels towards a stable a high quality teacher workforce at our nation's neediest schools. ProComp provides a unique opportunity to examine the effect of financial incentives on teachers' employment decisions because estimated effects should be generalizable to other large, urban school districts. As one of the most established alternative teacher compensation reforms, effects of ProComp HTS bonuses on teacher employment patterns should not be contaminated with implementation inconsistencies, inadequate resources, or incomplete information.

In what follows, relevant literature is reviewed. The next section presents the methodology, including participants, data sources, measures, and the analytic approach employed. Preliminary findings are then presented. Lastly, several provisional conclusions are offered based on the preliminary findings and directions for further research are discussed.

Review of Literature

Most literature that examines the effects of financial incentives on teacher and student outcomes has come from the field of economics. Labor economists in particular, have examined the effects of alternative teacher compensation with consideration to the economic theories of supply and demand and utility theory. In general, these studies have found that the traditional single-salary schedule does not appropriately account for differences across positions, schools, districts, or states. Teachers tend to "sort" themselves into schools that serve students who are most likely to be wealthy, high achieving, suburban, and who speak English as a first language (Ingersoll, 2001; Wyckoff, Boyd, Lankford & Loeb, 2003). As with other labor markets, the highest quality employees tend to have the most opportunities to sort themselves into schools that match their preferences and, thus, the neediest schools are often those with the fewest high-quality teachers.

As alternative teacher compensation programs have grown in popularity, there have been attempts to use financial incentives to "correct" for market inefficiencies by compensating teachers who work at needy schools with the hope these positions will become more attractive. Unfortunately, few studies have been conducted that examine the effects of these financial incentives on teacher retention at these schools. In part, this is because the incentives themselves are often short-lived, the criteria to qualify for the incentives are often unclear, or an evaluation of the program may never have been commissioned (Clotfelter, Glennie, Ladd & Vigdor, 2008). Findings from the few studies that have been conducted tend to be mixed.

In response to concerns about high teacher turnover in HTS schools, districts and states have implemented targeted financial incentives to attract and retain teachers at HTS schools (Darling-Hammond & Prince, 2007). Using the 2003-04 Schools and Staffing Survey, Podgursky (2008) estimates approximately five percent of districts reported providing financial incentives to teachers who worked in "less desirable locations." Johnson (2005) estimates at least seventeen states have implemented targeted financial incentives to attract and retain teachers at HTS schools. Though growing, the research on alternative teacher compensation in general is small (Podgursky & Springer, 2006) and research on the effects of offering financial incentives for working in HTS schools is smaller still. Despite this, there are several studies that have examined the effects of financial incentives on retention specifically at HTS schools. These studies best inform the design, expectations and ultimately, the interpretation of findings for this study.

Bruno and Negrete (1983) examined the effectiveness of paying teachers a substantial financial bonus (11 percent of salary) for working in seven racially isolated schools. They concluded such "combat pay" was not effective at retaining teachers to work at these schools. Furthermore, they found the teachers that were more likely to be retained after the bonus were more a function of supply side changes (young, inexperienced, or probationary teachers) rather than demand side changes (older, more experienced, licensed teachers who found the schools more attractive because of the salary increment). Given the fact that young, inexperienced, and probationary teachers were more likely to work at racially isolated schools before implementation of the bonus program, the authors concluded the money would be better spent reducing class size, improving building conditions, or other non-pecuniary benefits.

More recently, Clotfelter, Glennie, Ladd, & Vigdor (2008) found a moderately-sized retention bonus ($1,800, approximately 5 percent of salary) had no effect on retention for eligible teachers in North Carolina. Using a difference-in-differences strategy, the authors estimated the retention bonus, which targeted licensed mathematics, science, and special education teachers working in high-poverty or academically failing secondary schools, was negative and statistically insignificant. However, the authors point out that survey evidence suggested many eligible teachers did not understand the criteria to participate in the program and thus, results may have been subject to negative bias stemming from design and implementation flaws.

Steele, Murnane, and Willett (2009) recently studied retention effects of the Governor's Teaching Fellowship (GTF) incentive offered from 2000 to 2002 in California. The GTF was a competitive $20,000 incentive that sought to attract academically talented, novice teachers to low-performing schools and retain them at those schools for at least four years. GTF recipients who did not complete their four-year commitments would have to repay the state $5,000 for each year of unfulfilled commitment. All else being equal, GTF recipients had an incentive to stay in low-performing schools longer than non-recipients. However, using a descriptive discrete-time hazard model, the authors found no difference in the hazard probabilities of exit for GTF recipients and non-recipients. Roughly 75 percent of GTF recipients and the non-recipient

comparison group remained teaching in a low-performing school into the fourth year. Although no difference was observed between the two groups, the authors are careful to point out that the descriptive approach they employed did not account for any unobserved differences between the GTF recipient group and the non-recipient group, thereby limiting their ability to conclude whether GTF influenced retention rates either positively or negatively.

Lastly, a report published by the National Center on Performance Incentives on the Texas Educator Excellence Grant (TEEG) finds little evidence suggesting financial incentives were associated with increased retention. Springer et al. (2009) found little evidence to suggest that schools that participated in the TEEG program experienced any systematic reduction in teacher turnover within the first two implementation cycles of the program (fall 2007 and fall 2008). The authors speculate this may be due to very small bonuses received by some teachers but did note that teacher turnover was reduced as the size of the retention bonus increased[13]. For example, beginning and experienced teachers who received a retention bonus of $1,280 or more had a significantly lower predicted turnover rate than matched teachers who received a smaller bonus. In line with common sense, their findings suggest the size of financial incentives matter for effectively promoting teacher retention in HTS schools.

The few studies that have examined the effects of financial incentives on teacher retention at HTS schools raise questions about the ability of financial incentives to affect teacher employment decisions and also suggest the complicated nature of the challenges for retaining high-quality teachers to work at HTS schools (Milanowski et al., 2007). Clearly, far more research is needed on the potential effectiveness of financial incentives given the current interest in them as a policy to promote retention, particularly of high-quality teachers, at HTS schools.

Methodology

This section describes the methodology applied in the preliminary analyses of this study. The population of teachers and schools of interest in this study are described first. Second, the two primary sources of data are presented: 1) district human resource data; and 2) school characteristic data. Lastly, the preliminary descriptive approach employed thus far in the study is explained.

Population

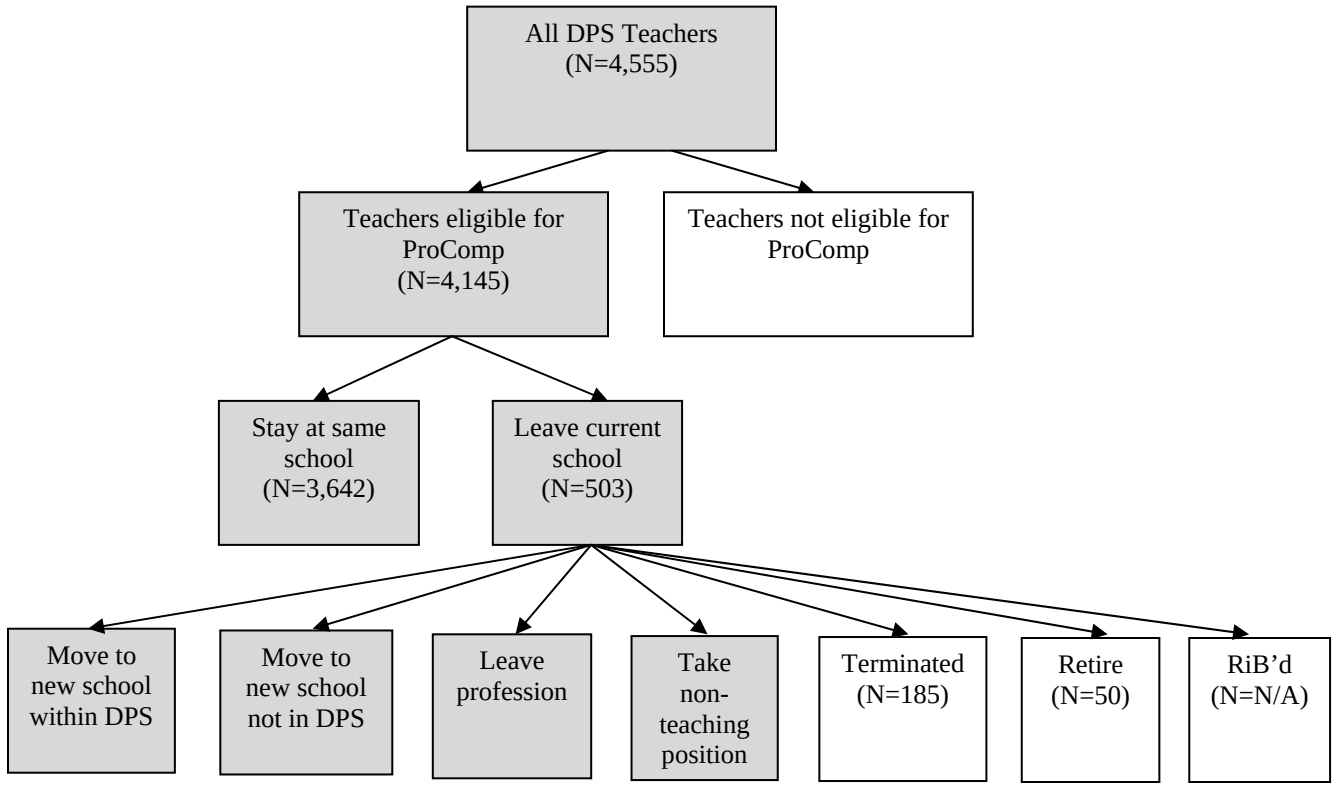
Under ProComp, the HTS bonus is potentially available to *most* teachers and *most* schools in the district are eligible to be designated "HTS" should their student population meet or exceed the threshold of students eligible to receive free- or reduced-price lunch (FRL). However, because availability of the bonus and designation are not universally available to all teachers and schools, it is important to specify participant teachers and schools.

Teachers

[13] Schools that participate in TEEG design their own alternative teacher compensation plan. Thus, bonus awards for desired outcomes vary from school to school.

Incentives offered under ProComp, including the HTS bonus, are available to DPS teachers[14], though the eligible population is constrained in several ways. Figure 9 shows the population of teachers eligible to participate in ProComp from 2005-06 to 2009-10, as well as the sample of teachers that were considered in retention analyses. To be eligible to participate in ProComp, teachers must be represented by the Denver Classroom Teachers Association (DCTA) [15]bargaining unit. Importantly, teachers who work at charter schools are not eligible to participate in ProComp and charter schools cannot be designated "HTS". To earn the HTS bonus – or other incentive offered under ProComp – eligible teachers must be actively enrolled in the ProComp pay system[16]. Teachers in all subject areas and grade levels are eligible to receive the HTS bonus. Given these requirements, the population of teachers eligible to participate in ProComp and with subsequent potential to receive the HTS bonus is roughly between 3,900 and 4,200 each year.

Figure 9. *Teachers eligible for ProComp and sample included in retention analyses.*[17]



[14] The HTS bonus and other incentives offered under ProComp are also available for student-services professionals (SSPs). These employees include – but are not limited to – school psychologists, nurses, social workers, and speech therapists. For the purposes of this study, however, SSPs have been excluded.

[15] DCTA is an affiliate of the National Education Association (NEA) and the Colorado Education Association (CEA) teachers' unions.

[16] The HTS bonus is not limited to full-time teachers. In fact, teachers must serve only one full day a month at a school designated "HTS" to qualify for the HTS bonus that month. However, teachers receive a percentage of the HTS bonus that equals their full-time employee (FTE) status.

[17] Numbers presented in Figure 9 are for the 2008-09 school year.

In addition to establishing teachers eligible to participate in ProComp, it is also important to articulate which teachers were included in retention analyses. Although seemingly straightforward, retention can be operationalized in a number of ways. Ideally, we would like to measure retention rates that include only teachers that are at least minimally competent to choose to remain at their current school from one year to the next. As such, we have excluded teachers who were terminated and those who retired. Ideally, the calculation of retention rates would also exclude teachers who left their schools involuntarily because of a reduction in available teaching positions – known as a "Reduction in Building" (RiB). However, we do not currently have access to these data, and thus retention rates presented herein include RiB'd teachers. For each year, the population of teachers included in retention analyses includes teachers eligible for ProComp who either stay in their same school or leave their school and: 1) move to a new school within or outside DPS; 2) leave the profession; or 3) take a non-teaching position. Retention rates are calculated from one year to the next by dividing the number of teachers who stay at their same school by the population explained above:

Numerator: Number of teachers who stayed at same school from one year to the next

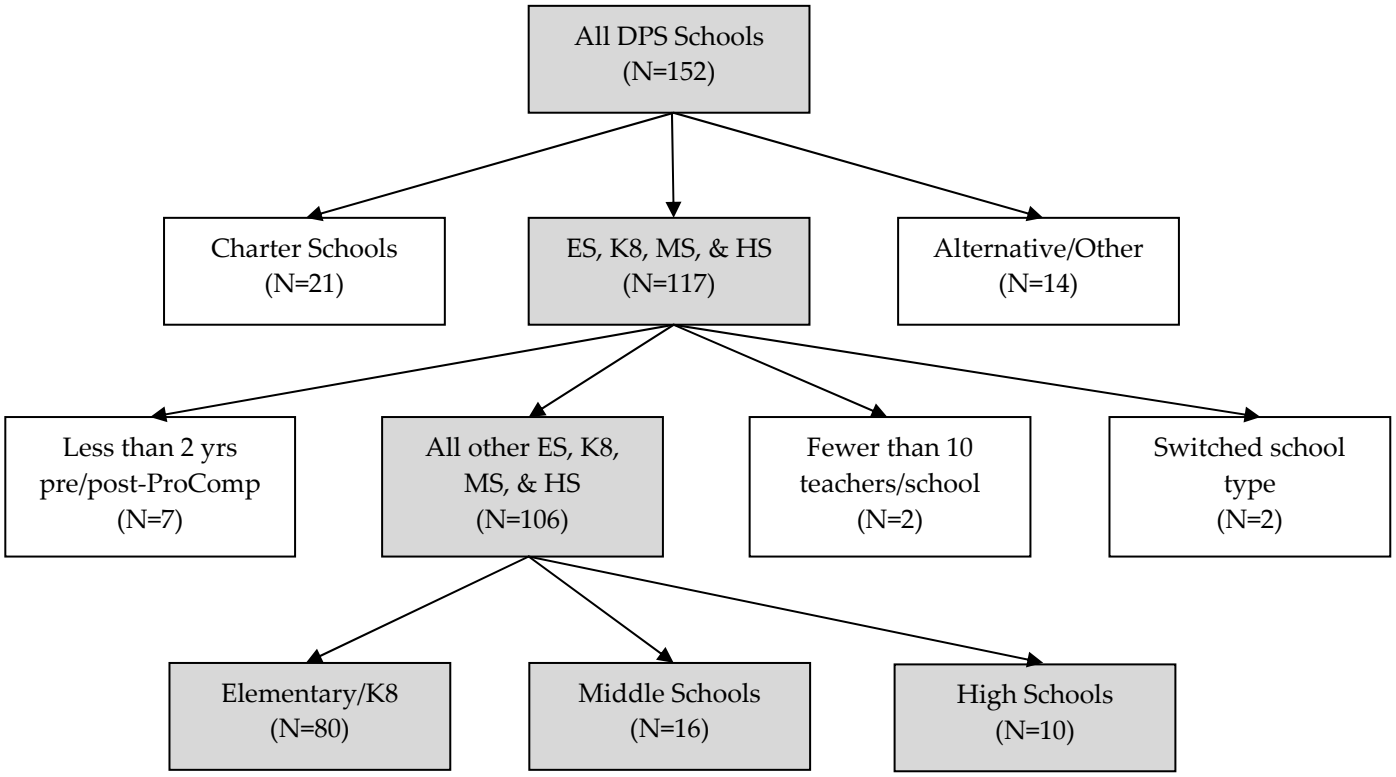
Denominator: Number of teachers eligible for ProComp who either stayed in the same school, or left school and: 1) moved to a new school within or outside DPS; 2) left the profession; or 3) took a non-teaching position

This study examined teacher retention rates with schools as the principal unit of analysis. Because many teachers wait to quit or move schools until the end of the summer, it is important retention rates be calculated after the start of the subsequent year. As such, school location information will be pulled from October for each teacher.

Schools

As with teachers, we were able to include most schools in the analyses of retention but not all. Figure 10 presents the sample of schools for the study.

Figure 10. *Sample schools included in retention analysis.*[18]



Because charter schools are not eligible to be designated "HTS" (nor are teachers who work at charter schools eligible to join ProComp), they were removed from the sample. Although alternative schools are automatically designated "HTS" (and teachers who work at alternative schools are eligible to participate in ProComp) these schools were removed from the sample because they tend to have few teachers and are designed to serve students with special circumstances. As such, retention trends from these schools are not generalizable to the larger population of DPS schools. Schools that were not in existence for a minimum of two years prior to the implementation of ProComp and a minimum of two years subsequent the implementation of ProComp were also removed from the sample because it was not possible to get a sense of the pre/post-ProComp trend in their retention rates. Schools with fewer than ten teachers were removed from the sample as retention rates calculated off such a small percentage of teachers tended to be very volatile. Finally, there were two schools that switched school types (e.g., from middle schools to K-8 schools). Because it is likely retention rates differ across school types, these schools were also removed from the sample. The restrictions described above were applied across years of data, yielding a sample of schools that ranged from 104 to 115.

In addition to specifying the sample of schools used for this study, it is important to clarify how schools were designated HTS during each iteration of ProComp. A different formula was used

[18] Numbers presented in Figure 10 are for the 2008-09 school year.

to designate schools "HTS" under the first iteration (2006-07 and 2007-08 school years) than under the second iteration (2008-09 to present school years) of ProComp. Table 20 shows the differences in the HTS bonus between the first iteration of ProComp and the second.

Table 20. *Changes in HTS bonus from first to second iteration of ProComp.*

	1st ProComp (2006-07 & 2007-08)	2nd ProComp (2008-09 to present)
Identification of schools	FRL, Medicaid, ELL, Special Ed, & crime rates*	Percentage of FRL**
Approximate N of schools	30	65
Duration of designation	3 years	1 year
Approximate FTE bonus amount	$1,030	$2,400
Index of bonus	3%	6.4%

*See Appendix I for further details on the formula used to identify HTS under the first iteration of ProComp.
**FRL thresholds are set to vary by school type[19]:

- 87+% FRL – Elementary K-8 Schools
- 85+% FRL – Middle Schools
- 75+% FRL – High Schools
- All "Provision II" Schools (those that provide free breakfast, lunch, and snacks to all their students)
- All "Alternative" Schools (those that enroll students because of special circumstances)

The HTS designation and associated financial bonus is reserved for the most impoverished schools in the district. It is available only for teachers who participate in ProComp. As such, the population of HTS schools (using schools identified under the first iteration of ProComp that were also identified under the second iteration of ProComp) consists of fairly stable list of approximately 30 schools and the population of teachers who could be eligible for the HTS bonus consists of approximately 4,100 teachers.

Data Sources

To explore the effects of the HTS bonus on teacher retention, two data sources will be used: 1) district human resource data; and 2) school characteristic data. The first source, Denver Public School (DPS) district human resource data, contains longitudinally linked teacher professional assignment records as well as fixed and time varying data on teacher characteristics. These panel data are available from six years prior and four years subsequent to the implementation of ProComp (2000-01 to 2009-10). Table 21 shows the relevant variables from the DPS human resource data.

[19] In order to avoid schools moving on and off the HTS list annually, there is a 5 percent margin for schools that have already been designated (see Appendix J for additional information).

Table 21. *Human resource variables.*

Variable	Description	Type	Longitudinal Variation
Year	School year	Continuous	Varying
Employee ID	DPS employee ID	Identification	Invariant
Location	School location	Categorical	Varying
Hire Date	DPS hire date	Date	Invariant
New	New teacher indicator	Categorical	Invariant
Start Date	Position start date	Date	Invariant
End Date	Position end date	Date	Invariant
PC Eligibility Date	ProComp eligibility date	Date	Invariant
PC Opting Date	ProComp opt-in date	Date	Invariant
PC Op-tin Type	ProComp opt-in type	Categorical	Invariant
Grade	Grade taught	Categorical	Varying
Subject	Subject taught	Categorical	Varying
HTS Bonus	HTS bonus award	Categorical	Varying
Stay	Retention indicator	Categorical	Varying

These data will not only be used to determine whether there are changes in rates of teacher retention but also to identify any changes in ProComp participation over time.

DPS and ProComp school-level information are the second data source from which this study draws. These data are also from 2000-01 to 2009-10 and include information considered for the identification of HTS schools. After the implementation of ProComp in 2006, these data also include information about which schools were designated HTS, as well as those schools who were eligible for other school-level bonuses, under the first and second iterations of ProComp. Table 22 shows the relevant variables that may be examined from the DPS and ProComp school characteristic data.

Table 22. *School characteristic variables*.

Variable	Description	Type	Longitudinal Variation
Year	School year	Continuous	Varying
DPS No	DPS school number	Identification	Invariant
CDE No	CDE school number	Identification	Invariant
Name	School name	Identification	Invariant
Type	School type	Categorical	Invariant
FRL	Percent FRL	Continuous	Varying
Minority	Percent Minority	Continuous	Varying
SPF	School Performance Framework rating	Categorical	Varying
DSTP	Distinguished/Top Performing School status	Categorical	Varying
HG	High Growth School status	Categorical	Varying
HTS	HTS status	Categorical	Varying
HTS_1	Historical HTS status using 1st PC criteria	Categorical	Varying
HTS_2	Historical HTS status using 2nd PC criteria	Categorical	Varying
HTS_3	Historical HTS status using percent FRL	Categorical	Varying

These variables enable us to identify which schools were designated HTS under the two different criteria used for the HTS bonuses and to identify schools that *would* have been designated HTS prior to the implementation of ProComp and under each of the two HTS bonus formulas.

Analytic Approach

As previously discussed, schools were the unit of analysis and retention rates were the outcome of interest. Given the availability of matched panel data from six years prior and four years subsequent to the implementation of ProComp, there were nine transition periods between school years during which teachers could either remain in their same schools or not. Table 23 shows the transitions between school years and how they are divided among treatment and control groups.

Table 23. *Transitions between school years.*

1. 2000-01 to 2001-02
2. 2001-02 to 2002-03
3. 2002-03 to 2003-04
4. 2003-04 to 2004-05
5. 2004-05 to 2005-06

ProComp Implemented

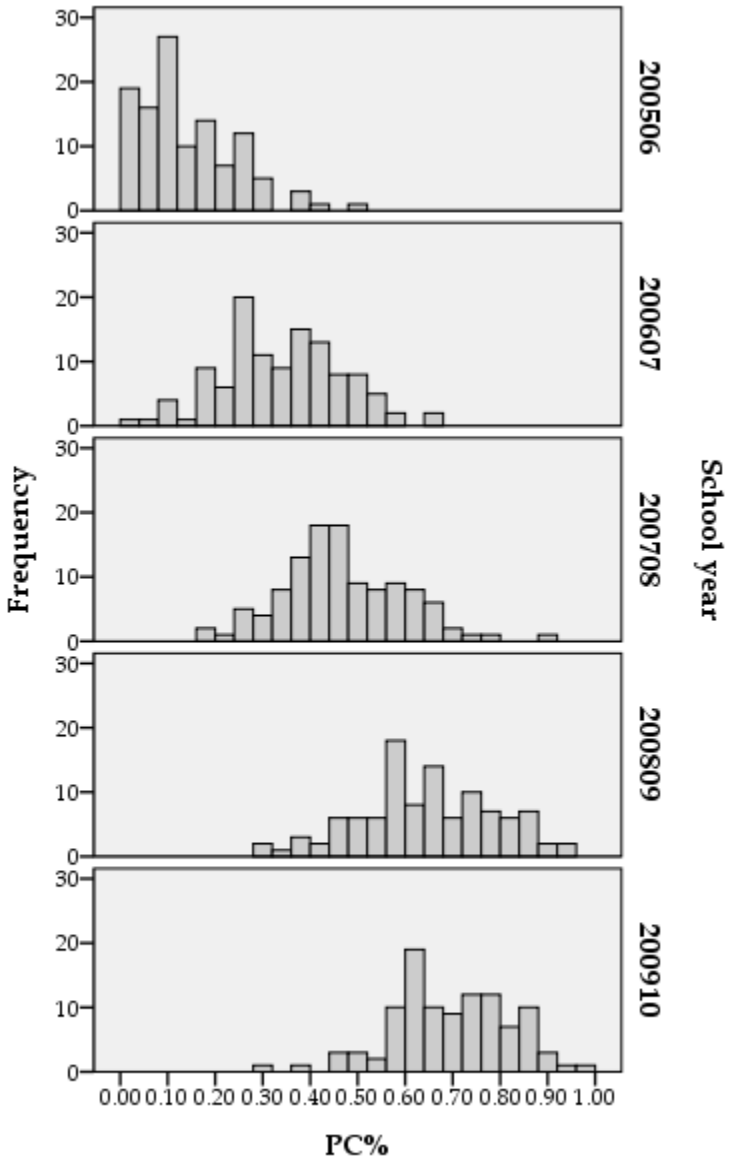
6. 2005-06 to 2006-07
7. 2006-07 to 2007-08
8. 2007-08 to 2008-09
9. 2008-09 to 2009-10

The first five transition periods all occur prior to ProComp; the last four occur after the implementation of ProComp. The analytic approach preliminarily employed in this study relied on descriptive statistics to explore the distribution of ProComp participation and retention over the transition periods specified above. As we were interested in understanding whether the HTS bonus under ProComp may be associated with improved retention, we examined schools by both the percentage of ProComp participation and "HTS" designation.

Findings

To further describe the district human resource data and the school characteristic data for the population of teachers and sample of schools eligible for the HTS bonus, descriptive statistics are provided in this section. To better understand the distribution of ProComp participation within schools over time, we examined histograms of participation and generated univariate statistics on ProComp participation. Figure 11 shows a series of histograms for each year of ProComp (staring in 2005-06, though ProComp was not implemented until January 1, 2006, through the current year). Along the x-axis is the percent ProComp participation (from 0-100%); along the y-axis is the number of schools (from 0-30 schools). Starting in 2005-06 it is clear to see the distribution of ProComp participation shifts left, increasing over time. Given that teachers new to DPS are required to join ProComp, this is exactly the trend in participation we would expect to observe.

Figure 11. *ProComp participation over time.*



In addition to trends visible in Figure 11, the mean and standard deviation (SD) of ProComp retention in the district are presented in Table 24. As Table 24 shows, the mean ProComp participation increases each year.

Table 24. *ProComp participation over time.*

	N	Minimum	Maximum	Mean	SD
2005-06	115	0	0.50	0.14	0.10
2006-07	115	0	0.67	0.34	0.13
2007-08	114	0.18	0.90	0.47	0.13
2008-09	106	0.29	0.95	0.64	0.14
2009-10	104	0.31	0.96	0.69	0.12

Another way to get a sense for changes in ProComp participation over time is to look at the average change in participation. Table 25 presents the average yearly change in ProComp participation for all schools[20].

Table 25. *Average yearly change in ProComp participation.*

	N	Minimum	Maximum	Mean	Median	SD	25th	50th	75th
PC Change	115	0.03	0.17	0.11	0.11	0.03	0.09	0.11	0.13

On average, ProComp participation increased by roughly 11 percent each year, though some schools had an average yearly increase of only 3 percent while others had an average yearly increase of 17 percent. The distribution of average yearly change in ProComp participation will be an important variable in future retention analyses.

To get a sense of which schools ultimately ended up with the highest ProComp participation we also examined the distribution of ProComp participation in the last year for which retention data were analyzed (2008-09). This will allow me for a simplistic comparison of retention over time between schools with varying levels of most recent ProComp participation. As Table 26. shows, we observed very little variation between quartiles.

Table 26. *Quartiles of ProComp participation in 2008-09.*

Percentile	Distribution
25th	0.56
50th	0.65
75th	0.75

Because there was such little variation between quartiles, (i.e., schools with 2008-09 ProComp participation at the 25th percentile had only 9% fewer participants than schools at the 50th percentile), we opted to compare the ProComp participation of schools using the 2008-09 ProComp participation median (65.12%). Schools at or above the 2008-09 ProComp participation median were designated "high" ProComp participation schools and those below the median

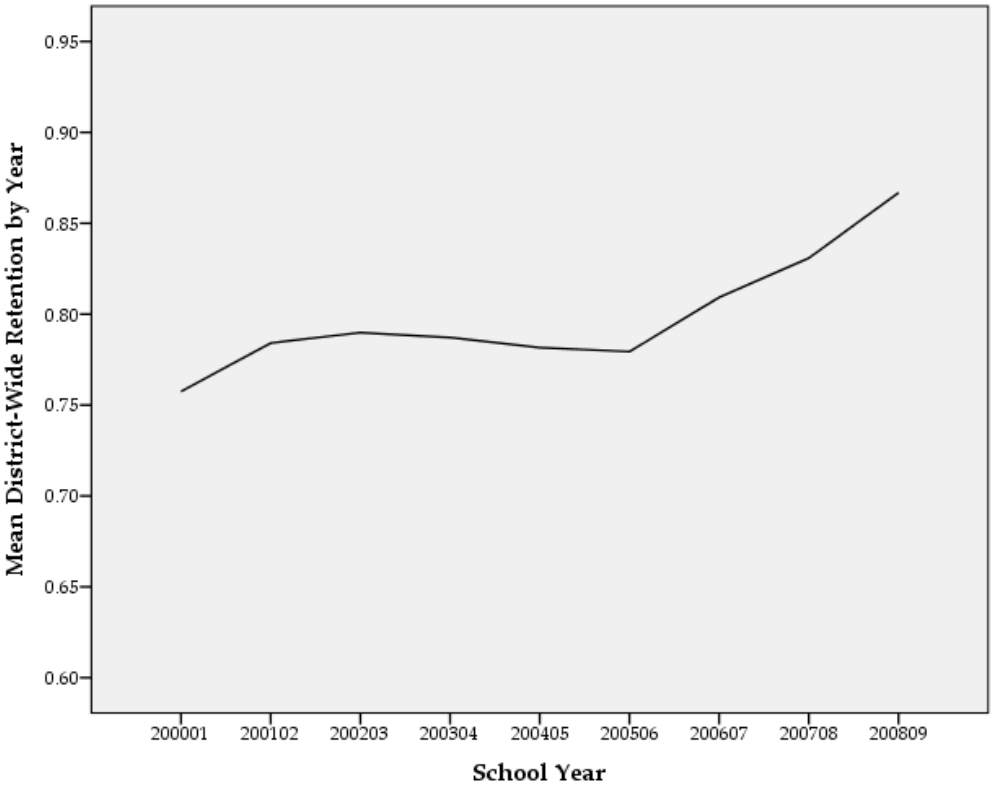
[20] While most schools had five years of available data after the implementation of ProComp, two schools had only four years of data, seven schools had only three years of data, and one school had only two years of data available.

were designated "low" ProComp participation schools. For the purposes of this simple comparison, median ProComp participation was not re-calculated each year since we wanted to establish consistent groups of "high" and "low" ProComp participation schools from which to initially compare retention rates over time.

We next examined within-school retention trends for the district as a whole. Retention rates were plotted over time, by high and low ProComp participation levels, by HTS school designation, and by both ProComp participation and HTS school designation. Years were plotted on the x-axes starting with the first year in the transition period (e.g., the transition period between 2000-01 and 2001-02 is indicated as "200001"). The percent of teachers retained in each school from one year to the next was plotted along the y-axes.

In Figure 12, we observe a general upward trend in within school retention (N=104-115 schools). Over the nine transition periods plotted, retention increased 11%, from roughly 75% to roughly 86%.

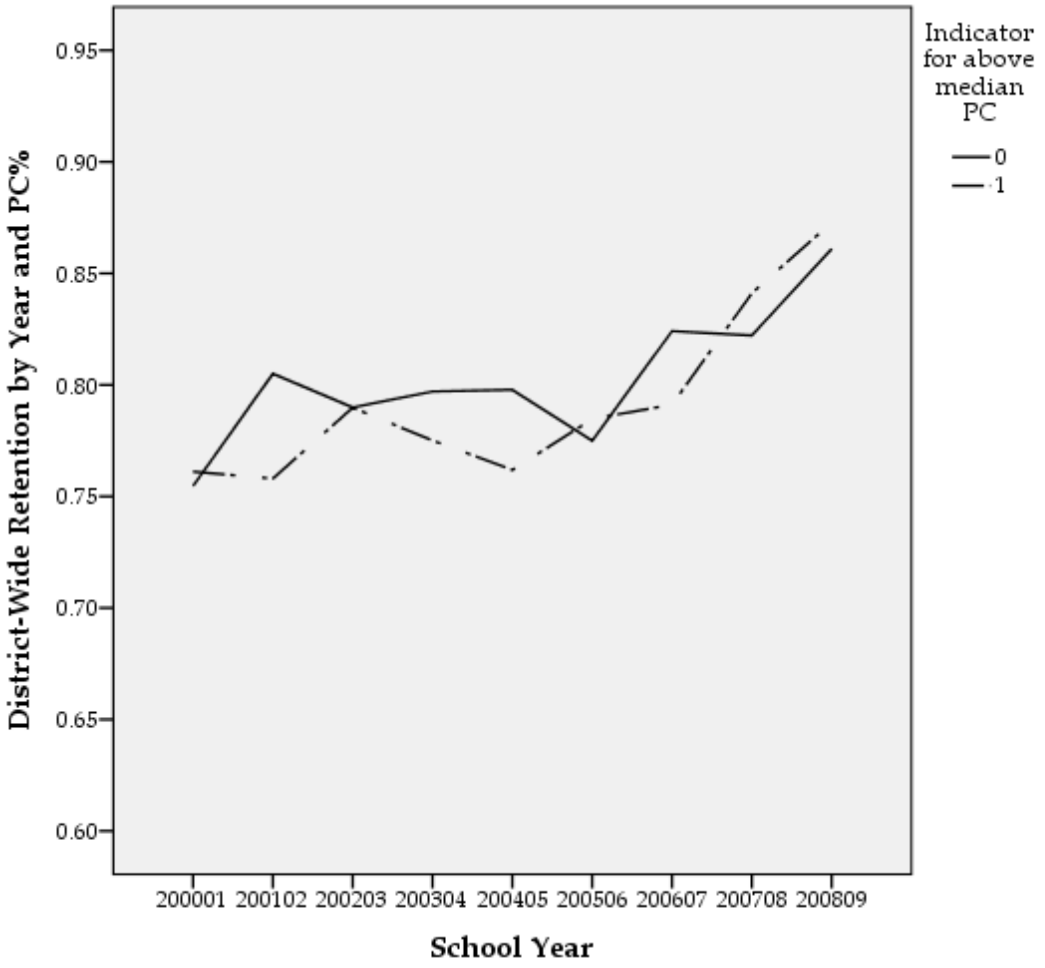
Figure 12. *Within-school retention trends for the district.*



Interestingly, there appears to be a sharp increase in retention from 2005-06 to 2006-07 during the time ProComp was implemented. However, because these statistics are merely descriptive, the increase could be due to any number of factors or combinations thereof (e.g., economy, satisfaction with the district, etc.).

Figure 13 also plots within school retention rates for the district as a whole but now disaggregated by ProComp participation level. Here, the same general upward trend in retention can be observed for high ProComp participation schools (N= 46-52) and low ProComp participation schools (N=53-63).

Figure 13. *Within-school retention trends for the district, disaggregated by ProComp participation.*

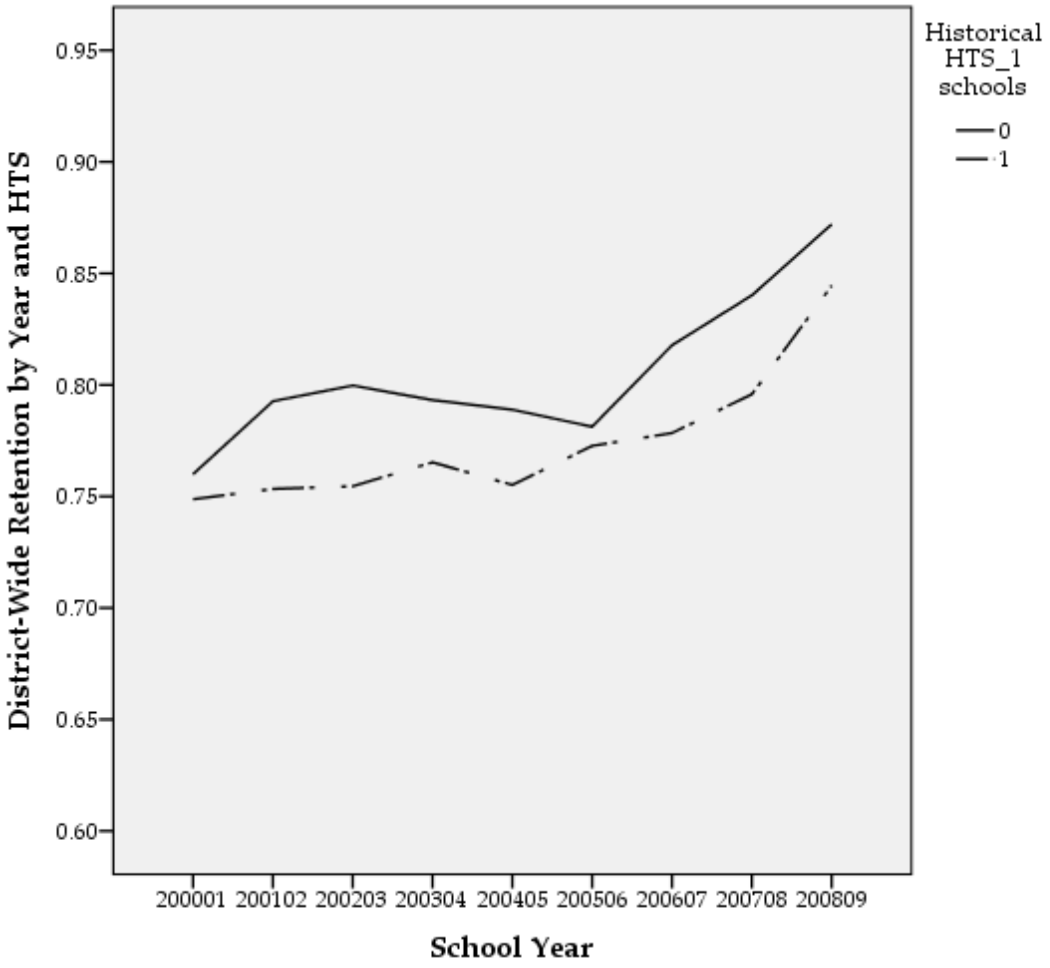


The designation of high or low ProComp participant school has been applied historically. Though schools at or above the median level of ProComp participation have a similar trajectory to schools below the median level of ProComp participation, high participation schools appear to have slightly higher rates of retention in the most recent years.

Within school retention trends overtime are examined next for HTS schools (N=20-25) and schools not designated as such (N=84-90). As HTS schools obviously did not exist prior to ProComp, this designation was applied historically to all schools identified HTS under the first iteration of ProComp. As a preliminary approach to identifying HTS schools historically, we decided to use schools identified as "HTS" under the first iteration because this was the more

conservative of the two criteria used to identify schools. Additionally, all schools designated "HTS" under the first criteria were also designated as such under the second criteria. Figure 14 shows that, despite a general upward trend in retention, retention rates at HTS schools continue to lag behind those of schools not designated HTS. There does not appear to be any evidence that this trend is shifting when analyzed in this way.

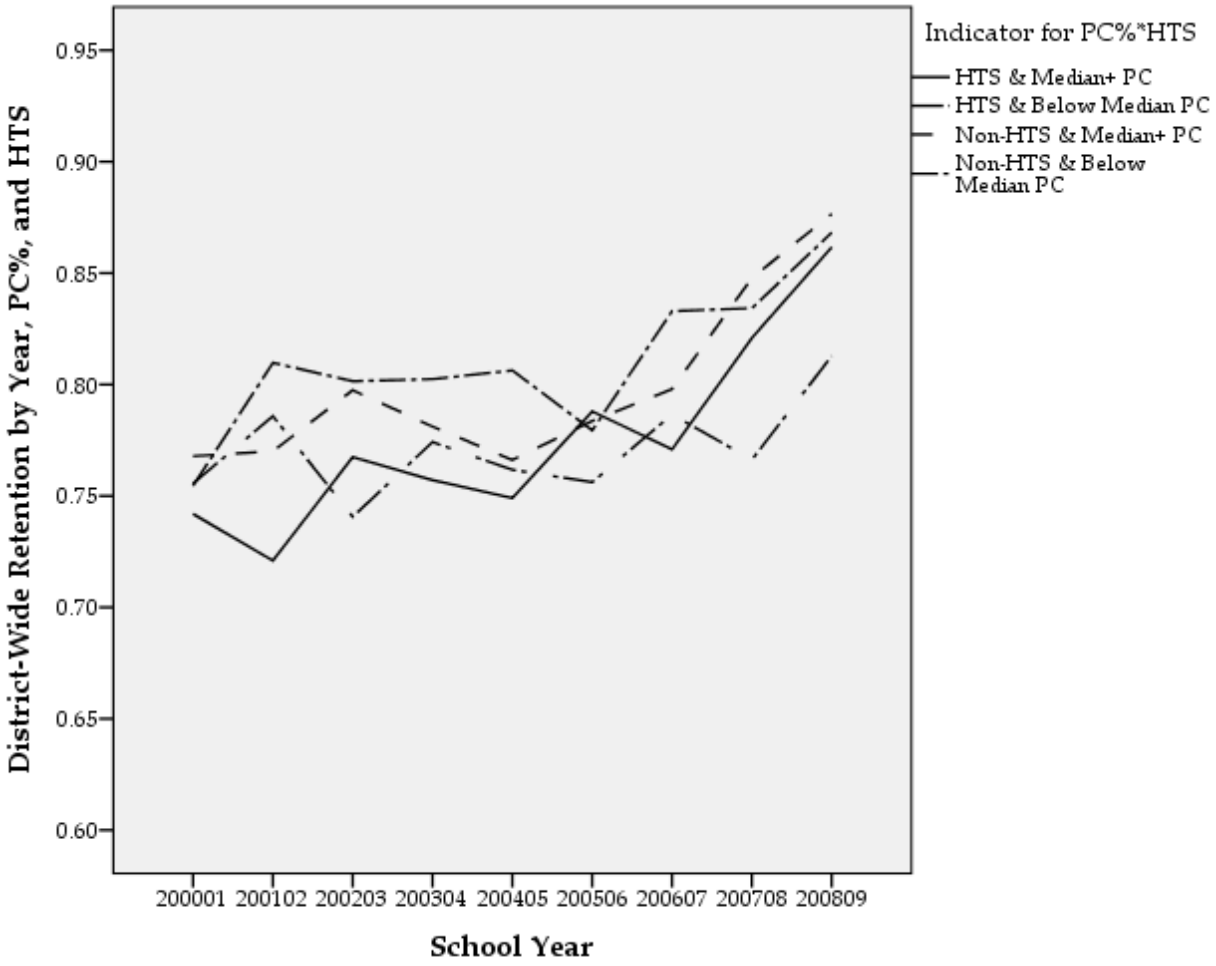
Figure 14. *Within-school retention trends for the district, disaggregated by HTS status.*



Perhaps the most interesting description of retention overtime is presented below in Figure 11. Plotting the same within-school retention rates over time, Figure 15 presents retention disaggregated by four groups: 1) HTS schools with high ProComp participation (N=12-13); 2) HTS schools with low ProComp participation (N=7-12); non-HTS schools with high ProComp participation (N=34-39); and non-HTS schools with low ProComp participation (N=46-51). As in previous analyses, an upward trend in retention is observed for all four groups, though it is noticeably flatter for HTS schools with low ProComp participation. Importantly, HTS school with high ProComp participation (i.e., schools with the most teachers who earn the HTS bonus) experience a sharp increase in retention starting in the first full year of ProComp (2006-07),

suggesting there may be an interaction between ProComp participation and HTS status. Furthermore, these same schools also experienced the greatest absolute increase (9%) in retention rates during the nine transition periods. Taken together, these preliminary findings suggest we ought to further explore the association between ProComp and HTS school designation on retention rates within schools overtime.

Figure 15. *Within-school retention trends for the district, disaggregated by ProComp participation & HTS status.*



Discussion

Over the past decade, DPS has generally experienced an upward trend in within school retention rates. Schools with ProComp participation that is at or above the median participation level (65.12%) have experienced higher rates of retention in recent years. Examined in isolation, longitudinal retention rates at HTS schools lag behind those of schools that are not designated "HTS". However, when HTS schools are examined in conjunction with ProComp participation level, a different story appears. Preliminary descriptive statistics suggest schools with ProComp

participation that is at or above the median participation level and that are designated "HTS" experienced a sharp increase in retention rates in the first full year ProComp was implemented (2006-07). These schools also saw the greatest increase in retention (from 74% to 86%) over the past decade. Such preliminary findings suggest there may be a positive effect on retention associated with ProComp and the HTS bonus.

However, because these preliminary findings were generated descriptively, it will be important to continue these analyses. Namely, future analyses must attempt to address biases that might confound results. For example, it may be the case that school climate at HTS schools has a positive effect on both ProComp participation and retention. This may lead one to conclude ProComp participation combined with the HTS designation has resulted in improved retention when, actually, the true cause may have been school climate. In future analyses, we plan to employ a within-school fixed effect specification which will factor out all time invariant variables (like school climate) that may bias retention.

Additionally, it seems prudent to talk to teachers about the ways in which they consider – if at all – the HTS bonus and HTS school designation when making their employment decisions at the end of each school year. We plan to conduct semi-structure interviews with a purposefully selected sample of teachers to understand what they think about the financial bonus attached to HTS as well as the school label associated with this incentive. Although the HTS bonus is intended to make HTS schools more attractive to teachers, one could imagine a scenario where the HTS designation acted as a disincentive, particularly if it was interpreted as an early warning of future school-wide sanctions for failure to make adequate yearly progress (AYP) under the No Child Left Behind Act. Because it is not clear how teachers consider the HTS bonus and HTS school designation when making their employment decisions at the end of the school year, it is necessary to conduct interviews to better understand their considerations (or lack thereof).

Although some elements included in ProComp specifically aim to improve teacher quality, the HTS bonus is not one of them. As such, it makes little sense to assume teacher quality in HTS schools would be directly impacted by the HTS bonus. Rather, the hope is that the HTS bonus will improve teacher retention at HTS schools, tempering high rates of teacher turnover which are undesirable both because they are disruptive and because they force schools to hire large numbers of new teachers, many of whom are likely to be novice teachers. Because novice teachers are likely to be less effective than their more experienced counterparts (Clotfelter et al., 2008), improvements in retention may be associated with improvements in overall teacher value-added estimates as well as average experience at HTS schools. As such, it will be important to explore teacher quality before and after the implementation of ProComp and in HTS schools and non-HTS schools. This future exploration will make no claims of causality. Rather, this analysis will be purely descriptive and will attempt to explore simultaneous changes in ProComp, retention, and teacher quality.

Lastly, future analyses will need to address complications not resolved in the data analyzed herein. Specific to the sample of teachers included in preliminary retention analyses, two issues still need to be resolved: 1) RiB'd teachers need to be removed from the sample; and 2) teachers prepared by non-traditional teacher preparation programs need to be addressed. There are at least three non-traditional teacher preparation programs in Denver that specifically seek to place new teachers in high-poverty schools: Teach for America, Denver Teaching Fellows, and Denver Teacher Residency. Each of these programs requires that their participants teach a minimum of two – five years in exchange for training provided by the program. Since teachers in these programs are committed to working in the same high-poverty school for a certain length of time, their retention in a given school from one year to the next may more likely be a result of their commitment to the program rather than the availability of the HTS bonus under ProComp. In addition to complicating the computation of retention rates, these programs also pose a serious historical threat to the validity of the effect estimates for the HTS bonus on teacher retention. Although it is not entirely clear how to address this set of teachers, they need to be accounted for in future analyses.

Thus, despite preliminary evidence that suggests there might be an association between the availability of the HTS bonus under ProComp and improved retention rates, particularly at HTS schools, there is much additional work to be done. After analyses described above have been completed, we will be able to conclude with more certainty what the effects of the HTS bonus are – if any – on teacher retention in HTS schools.

CHAPTER V: Conclusion

The final chapter of this report provides our conclusions from the analyses presented herein. We first summarize program-level findings. Next, we highlight some of the limitations of this study. Finally, we describe next steps for our analyses.

Summary of Findings

The analyses detailed in this report suggest generally positive achievement outcomes in DPS since 2002-03 school year. District-wide achievement has steadily increased during this time, a trend evident in both mathematics and reading. Increases have been substantial; teachers' median conditional growth percentiles have seen a 3-8% increase over the past eight years

Analyses described herein examine whether evidence is consistent with composition and productivity effects associated with ProComp. Teachers hired post-ProComp (during which time participation has been mandatory) consistently demonstrate greater first-year achievement than those hired prior to the program, and these differences persist through teachers' first three years in DPS. Both of these findings are consistent with ProComp *composition effects*, though both may also reflect other policies and contextual factors at play in the years since 2005-06 implementation. Evidence of *productivity effects* associated with ProComp is less clear. Achievement effects of voluntarily ProComp participants do increase slightly upon opting into the program; however, the degree to which these differences represent a causal effect of the ProComp program, as opposed to differences between participants and non-participants that existed prior to ProComp, is still an open question.

Attitudes toward ProComp reported by teachers and principals in a 2009 survey are generally favorable. As expected, teachers who participate in ProComp hold more favorable views of ProComp than those who are not in ProComp; that this holds for both voluntary participants *and* newly-hired teachers required to participate suggests that the DPS teacher workforce is increasingly made up of teachers supportive of the program. On average, principals tended to report more favorable beliefs about ProComp than teachers did, particularly with regard to the potential of ProComp to increase student achievement.

Our examination of the relationship between teacher attitudes about ProComp and reported changes in their instructional behaviors suggests a positive relationship between the two. Teachers who reported favorable attitudes towards ProComp were more likely to report they had changed their instructional behavior and practices. Interestingly, this positive relationship was moderated by the prior receipt of the Exceeds Expectations incentive. We speculate this may be because teachers who have been formally acknowledge and rewarded by the district for excellent teaching may have less reason to alter their instructional behaviors and practices.

In addition to general increase in student achievement growth, there has also been an upward trend in teacher retention across the district in the past decade. Schools with higher ProComp

participation levels have experienced higher rates of retention in the most recent years though retention at hard-to-serve schools lagged behind those of schools that are not designated "hard-to-serve" when examined in isolation. However, when retention trends were examined for schools with greater rates of ProComp participation that were also designated "hard-to-serve," a sharp increase in retention rates was observed in the first full year ProComp was implemented (2006-07). This increase continued through the most recent year for which retention data are available (2008-09). Such a pattern suggests there may be a positive effect on retention trends associated with ProComp and the hard-to-serve bonus and warrants further exploration.

Limitations

Interpretation of the findings presented in this report must be conditioned on the study's limitations, many of which we discuss below. Most significant is the observational nature of our study; though many analyses suggest positive outcomes due to ProComp, our analyses cannot rule out other confounds that could have contributed to these results. Several potential confounds and other study limitations are discussed below.

First, other district reforms were implemented concurrent with ProComp. Educational reforms do not operate independent of all other things going on in a school district. DPS welcomed new superintendent Michael Bennett during summer, 2005 – several months before the ProComp ballot measure, yet several months after the execution of the ProComp joint agreement. Soon afterward DPS initiated the "Denver Plan" comprehensive initiative toward improving student achievement (into which ProComp was integrated). ProComp and the Denver Plan share similar timelines; as such, the analyses reported above cannot definitively attribute effects to one or the other.

In the same way that particulars of the district context introduce confounds to causal attribution, so too do state and federal policy contexts. The timeframe examined in this study was significantly influenced by the increased role of testing and accountability ushered in by the federal *No Child Left Behind* Act. Colorado initiated several reforms that could have influenced outcomes over the time period examined here; major reforms include:

- 1998: Colorado HB 98-1209; required that Colorado teacher preparation programs be evaluated on the basis of how well they train teachers in standards-based education.
- 2001: School Accountability Act; initiated annual School Accountability Reports
- 2004: Longitudinal Student Academic Growth Bill (HB 04-1433): established an achievement growth model for diagnostic purposes at a student level
- 2007: Longitudinal Student Assessment Bill (HB 07-1048): established an achievement growth model state accountability purposes

- 2008: Preschool to Postsecondary Education Alignment Act (Senate Bill 08-212): established the Colorado Achievement Plan for Kids (CAP4K) to establish a single educational system aligned from preschool to postsecondary levels.

Denver's demographic and economic context could have contributed to these results as well. The first decade of the 2000's saw substantial population growth in the Denver metro area. At the same time, the local economy entered a period marked by substantial unemployment, state budget shortfalls, and reduced funding from private foundations. These factors likely affected available teacher labor pools as well as teachers' individual employment decisions.

The Colorado Student Assessment Program (CSAP) was established in 1997 and gradually phased in for all students in grades 3 to 10. In 2001 the CSAP became somewhat of a high-stakes assessment as it provided the basis for school-level achievement measures as part of the Colorado School Accountability Report. As with any high-stakes assessment, any gains in CSAP performance since 2001 may be affected by *test score inflation* – that is, initial assessment score increases that exceed actual learning gains in the subjects targeted by the test (Koretz, et al., 1991).

As with any empirical study, the quality of our analyses (and resultant trustworthiness of findings) is only as good as the quality of our data. One of the most challenging aspects of data collection for educational policy evaluation is the establishment and verification of links between students and teachers. Though we believe our data to be as accurate as possible, we cannot fully verify whether this is the case.

Finally, achievement analyses reported herein are necessarily constrained to teachers of students who complete CSAP mathematics and reading assessments. This is relatively small subset of teachers relative to the entire ProComp-eligible teacher pool. Any inferences regarding ProComp and achievement, then, must be limited to effects on teachers characterized by this subset. Subsequent analyses may extend the scope of achievement effects by considering additional achievement-related outcomes (e.g., graduation; course-taking).

Directions for further research

The majority of outcomes reported in this report reflect potential effects at an aggregate (district-wide) level. Extensions of analyses of ProComp's effects on achievement and attitudes have yet to focus upon (1) the degree to which program effects vary as a function of characteristics of teachers; (2) the degree to which individual ProComp components variously contribute to ProComp outcomes; or (3) longitudinal trends in teacher attitudes and student achievement.

In addition to exploring these new aspects of ProComp's influence on student achievement and teacher attitudes, subsequent analyses will also expand on the analyses presented in Chapter III (Teachers' Attitudes, Behaviors, & Student Achievement) and Chapter IV (ProComp and Retention at Hard-to-Serve Schools).

Analyses extending the lines of inquiry detailed in Chapter III target a better understanding of the relationship between attitudes, behaviors, and student achievement; in particular, we plan to explore whether receipt of the 2009 Exceeds Expectations incentive can be predicted via 2009 reported changes in instructional behaviors. Additionally, we will model changes in the percent of students above the 55th percentile in 2008 and in 2009 to determine whether changes in student achievement gains are predicted by reported changes in teachers' instructional behaviors. Such an exploration will inform relationship 4 in the logic model presented in Chapter III and will provide insight as to whether achievement of teachers' students (and earning student achievement incentives) can be predicted by reported changes in teachers' instructional behaviors.

Finally, multiple analyses are planned to better understand the effects of ProComp and the HTS bonus on teacher retention. First, we will employ a within-school fixed effect specification to help factor out time invariant variables (like school climate) that may bias retention. Second, we will talk to teachers about the ways in which they consider – if at all – the HTS bonus and HTS school designation when making their employment decisions at the end of each school year to better understand any observed changes in retention associated with ProComp and the HTS incentive. Third, we will explore the extent to which changes in teacher quality are observed concurrent with changes in teacher retention. Lastly, future analyses will address complications not resolved in the data analyzed.

All of these will serve to provide greater understanding about the influence of ProComp, aspects that may be targeted for change, and components that may be worth considering in other compensation reforms.

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Appendix A: ProComp Incentives Chart: 2005-06 – 2007-08

2005-06 – 2007-08 ProComp Incentives Chart

Components Index $35,568	Knowledge and Skills			Professional Evaluation		Market Incentives		Student Growth		
Element	Professional Development Units	Grad Degree/Nat. License & Certificates	Tuition Reimburse	Probationary	Non-Probationary	Hard to Staff Position	Hard to Serve School	Student Growth Objectives	CSAP Expectations	Distinguished Schools
	2% of Index Salary Increase	9% of Index Salary Increase	$1,000 Lifetime Account	1% of Index Salary when rated satisfactory	3% of Index Salary when rated satisfactory	3% of Index Bonus	3 % of Index Bonus	1% Index Salary if both objectives met 1% Index Bonus if 1 objective met	3% of Index sustainable increase for exceeding expectations; 3% Index sustainable decrease for falling below expectations	2% of Index Bonus
$ Amount	$711	$3,201	$1,000	$356	$1,067	$1,067	$1,067	$356	$1,067	$711
Builds pension & highest salary?	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Appendix B: ProComp Incentives Chart: 2008-09– to Present

2008-09 to Present ProComp

Component of Index $37,551	Knowledge and Skills			Comprehensive Professional Evaluation		Market Incentives		Student Growth			
Element	Professional Development Unit	Advanced Degree and License	Tuition and Student Loan Reimbursement	Probationary	Non-Probationary	Hard to Serve School	Hard to Staff Assignment	Student Growth Objectives	Exceeds CSAP Expectations	Top Performing Schools	High Growth School
Description of Element	Providing ongoing professional development – tied to the needs of our students – is a central strategy to help you expand your skills, improve student performance, and advance your career with the district.	Compensation for Graduate Degree or Advanced Licenses or Certificates.	Reimbursement for tuition or for outstanding student loans.	Increases for new teachers based on a satisfactory evaluation.	Increases based on a satisfactory evaluation.	Designed to attract teachers to schools with a high free and reduced lunch percentage.	Designed to attract teachers to roles with high vacancy rate and high turnover.	Incentive paid for meeting student growth objectives.	Teachers whose assigned student's growth in CSAP scores exceed district expectations.	Teachers in schools designated as a "Top Performing School" based on the DPS School Performance Framework.	Teachers in schools designated as a "High Growth School" on the DPS School Performance Framework.
Eligibility and Payout	Base building for 1st PDU earned in if 14 or fewer years of service. 2nd PDU earned is banked and paid based on years of service at payout. (14 or less is base building. >14 is non-base building) [1]	Paid upon receipt of documentation that the license or certification is active and current.	Paid upon receipt of evidence of payment for and satisfactory completion of coursework; $4,000 lifetime account; no more than $1,000 per year.	Requires Satisfactory Evaluation: If unsatisfactory, ineligible for CPE increase.	Payable only to teachers who have a formal evaluation during service credit years 1-14.	Teachers currently serving in schools designated "Hard-to-Serve".	Teachers currently serving in designated "Hard-to-Staff" positions.	Base building when 2 SGOs are met, non base-building when only 1 SGO is met during prior school year[4]	Paid based on assigned student CSAP growth percentiles. Paid based on results from prior school year.	Paid based on performance during the prior school year.	Paid based on performance during the prior school year.
Affect on Base Salary	Base Building[2]	Base Building	Non-Base Building	Base Building	Base Building	Non-Base Building	Non-Base Building	Base Building[4]	Non-Base Building	Non-Base Building	Non-Base Building
Percent of Index	2%	9% per degree or license. Eligible once every 3 yrs	N/A	1% every year	3% every three years	6.4%	6.4%	1%	6.4%	6.4%	6.4%
Dollar Amount	$751	$3,380	Actual expense up to $1000/yr, $4000 lifetime	$376	$1,127	$2,403 $200.27/mo	$2403 ($200.27 per mo) x (# of assignments held)	$376.00	$2,403.26	$2,403.26	$2,403.26
Builds pension and highest average salary	Yes	Yes	No[3]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Payment Type and Frequency	Monthly installments upon submission of proper documents	Monthly installments upon submission of proper documents	Up to $1000 per year upon submission of proper documents	Prorated over 12 months. If unsatisfactory delayed at least 1 yr	Prorated over 12 months. If unsatisfactory delayed at least 1 yr	Monthly installment upon completion of service each month	Monthly installment upon completion of service each month	1 objective: Paid lump sum. 2 objectives: Paid in monthly installments	Paid lump sum in the year following assessment	Paid lump sum in the year following assessment	Paid lump sum in the year following assessment

Source: ProComp Website. Retrieved January 14, 2010 from: http://denverprocomp.dpsk12.org/

Appendix C: Correlations of Instructional Behavior Items

	Q1	Q2	Q3
Change the content of what I teach (Q1)	1.00	0.78**	0.62**
Change the way I teach (e.g. by using different teaching methods) (Q2)	0.78**	1.00	0.74**
Focus my teaching more on raising student achievement (Q3)	0.62**	0.74**	1.00

** Correlation is significant at the 0.01 level (2-tailed).

Appendix D: Correlations of Attitudinal Items

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
ProComp can motivate participants to improve instructional practices. (Q1)	1.00	.784**	.597**	.559**	.587**	.522**	.644**	.638**
ProComp can ultimately improve student achievement. (Q2)	.784**	1.00	.639**	.572**	.596**	.525**	.674**	.675**
ProComp will help DPS attract and retain qualified teachers. (Q3)	.597**	.639**	1.00	.565**	.606**	.607**	.679**	.598**
ProComp is aligned with the goals of our school district. (Q4)	.559**	.572**	.565**	1.00	.674**	.506**	.558**	.543**
ProComp is aligned with my goals as an educator. (Q5)	.587**	.596**	.606**	.674**	1.00	.565**	.611**	.624**
ProComp is a fair program. (Q6)	.522**	.525**	.607**	.506**	.565**	1.00	.676**	.587**
The financial incentives in ProComp will lead to improved instructional practice. (Q7)	.644**	.674**	.679**	.558**	.611**	.676**	1.00	.734**
ProComp provides a more focused way to think about my work. (Q8)	.638**	.675**	.598**	.543**	.624**	.587**	.734**	1.00

** Correlation is significant at the 0.01 level (2-tailed).

Appendix E: Factor Analysis of Behavior

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Question 2: Change the content of what I teach	2.64	1.37	1870.00
Question 2: Change the way I teach (e.g. by using different teaching methods)	2.89	1.35	1870.00
Question 2: Focus my teaching more on raising student achievement	3.21	1.36	1870.00

Communalities

	Initial	Extraction
Question 2: Change the content of what I teach	1.00	0.80
Question 2: Change the way I teach (e.g. by using different teaching methods)	1.00	0.88
Question 2: Focus my teaching more on raising student achievement	1.00	0.76

Extraction Method: Principal Component Analysis.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	Pct of Variance	Cumulative Pct	Total	Pct of Variance	Cumulative Pct
1	2.434	81.149	81.149	2.434	81.149	81.149
2	0.381	12.698	93.847			
3	0.185	6.153	100			

Extraction Method: Principal Component Analysis.

Component Matrix

	Component 1
Question 2: Change the content of what I teach	0.89
Question 2: Change the way I teach (e.g. by using different teaching methods)	0.94
Question 2: Focus my teaching more on raising student achievement	0.87

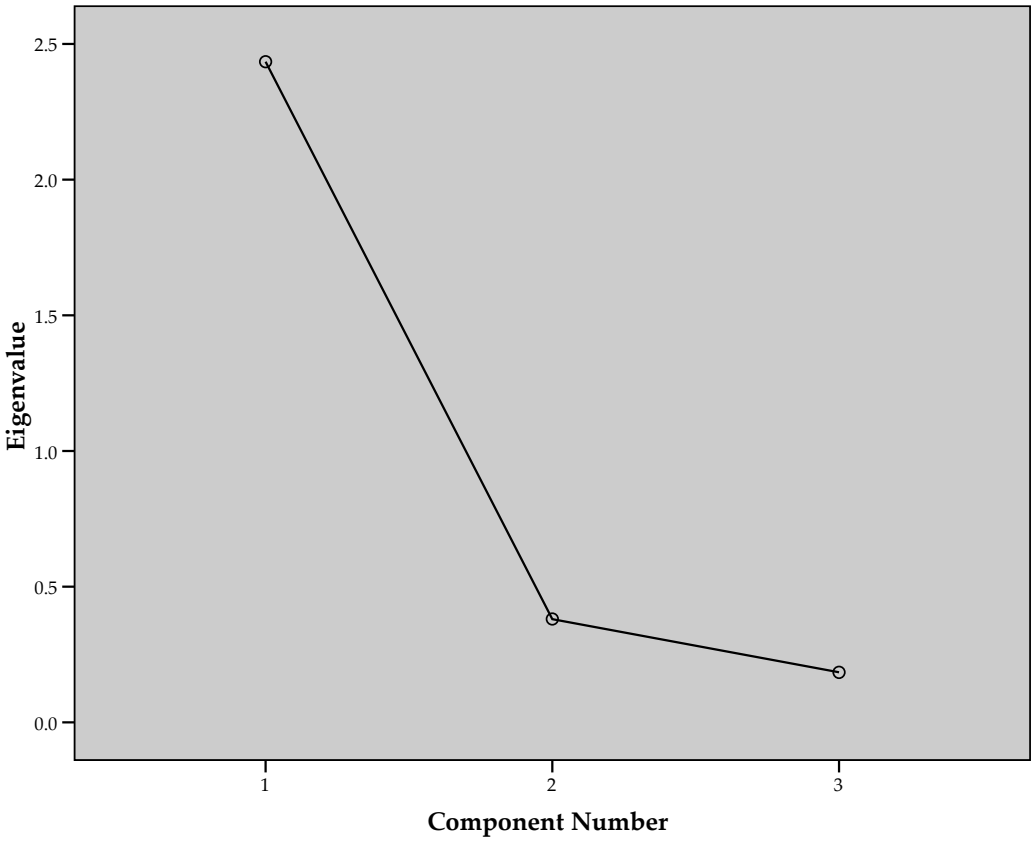
Extraction Method: Principal Component Analysis (1 components extracted)

Component Score Coefficient Matrix

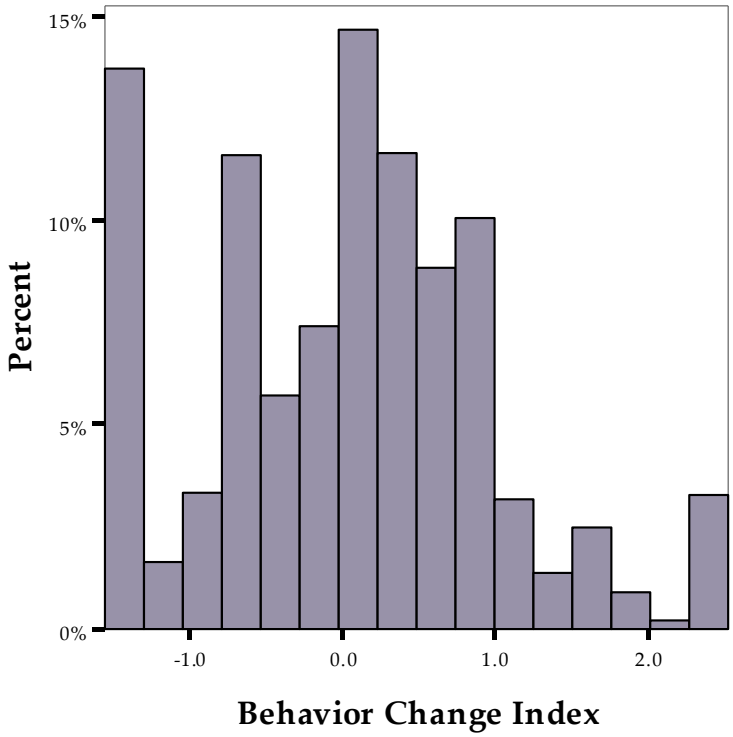
	Component 1
Question 2: Change the content of what I teach	0.37
Question 2: Change the way I teach (e.g. by using different teaching methods)	0.39
Question 2: Focus my teaching more on raising student achievement	0.36

Extraction Method: Principal Component Analysis Component Scores.

Scree Plot



Distribution of Behavior Index (Variable Created)



Appendix F: Factor Analysis of Attitude

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Question 10: ProComp can motivate participants to improve instructional practices.	3.40	1.01	1795.00
Question 10: ProComp can ultimately improve student achievement.	3.20	1.05	1795.00
Question 10: ProComp will help DPS attract and retain qualified teachers.	3.08	1.13	1795.00
Question 10: ProComp is aligned with the goals of our school district.	3.53	0.862	1795
Question 10: ProComp is aligned with my goals as an educator.	3.44	1.028	1795
Question 11: ProComp is a fair program.	3.11	1.079	1795
Question 11: The financial incentives in ProComp will lead to improved instructional practice.	3.06	1.14	1795
Question 11: ProComp provides a more focused way to think about my work.	3.04	1.077	1795

Communalities

	Initial	Extraction	Analysis N
Question 10: ProComp can motivate participants to improve instructional practices.	1.00	0.68	1795.00
Question 10: ProComp can ultimately improve student achievement.	1.00	0.71	1795.00
Question 10: ProComp will help DPS attract and retain qualified teachers.	1.00	0.66	1795.00
Question 10: ProComp is aligned with the goals of our school district.	1.00	0.58	1795
Question 10: ProComp is aligned with my goals as an educator.	1.00	0.66	1795
Question 11: ProComp is a fair program.	1.00	0.59	1795
Question 11: The financial incentives in ProComp will lead to improved instructional practice.	1.00	0.74	1795
Question 11: ProComp provides a more focused way to think about my work.	1.00	0.69	1795

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	Pct of Variance	Cumulative Pct	Total	Pct of Variance	Cumulative Pct
1	5.32	66.46	66.46	5.32	66.46	66.46
2	0.60	7.43	73.89			
3	0.58	7.26	81.16			
4	0.40	5.03	86.19			
5	0.36	4.44	90.63			
6	0.31	3.87	94.50			
7	0.23	2.90	97.39			
8	0.21	2.61	100.00			

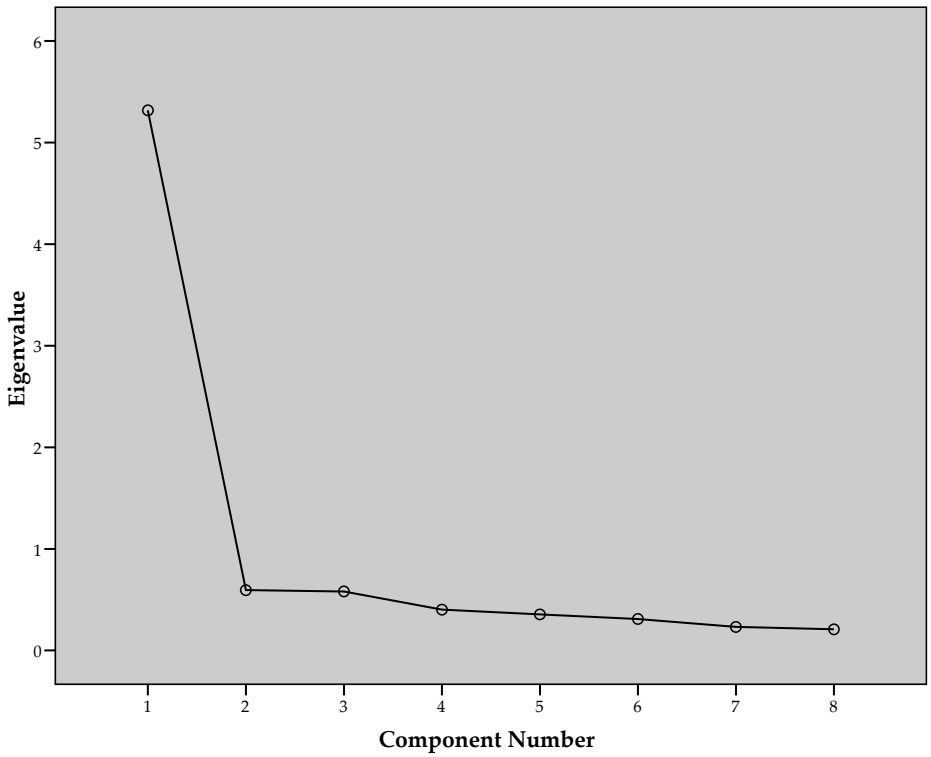
Extraction Method: Principal Component Analysis.

Component Matrix

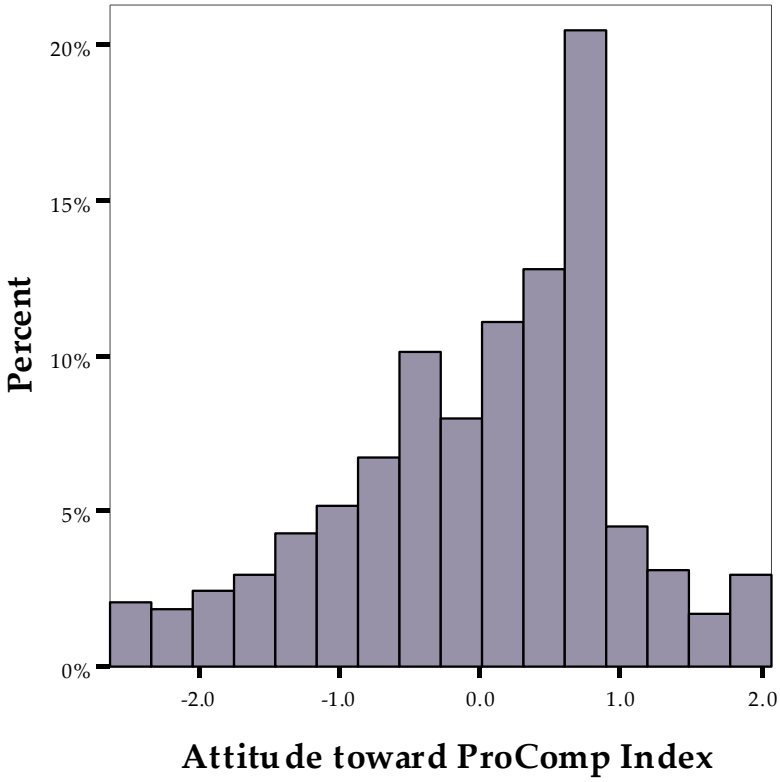
	Component 1
Question 10: ProComp can motivate participants to improve instructional practices.	0.82
Question 10: ProComp can ultimately improve student achievement.	0.84
Question 10: ProComp will help DPS attract and retain qualified teachers.	0.81
Question 10: ProComp is aligned with the goals of our school district.	0.76
Question 10: ProComp is aligned with my goals as an educator.	0.81
Question 11: ProComp is a fair program.	0.77
Question 11: The financial incentives in ProComp will lead to improved instructional practice.	0.86
Question 11: ProComp provides a more focused way to think about my work.	0.83

Extraction Method: Principal Component Analysis (1 components extracted)

Scree Plot



Distribution of Attitude Index (Variable Created)



Appendix G: Models Predicting Behavioral Change

Model 1: Attitudes

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	423.865(a)	1	423.865	566.074	.000
Intercept	.245	1	.245	.327	.568
Attitudes	423.865	1	423.865	566.074	.000
Error	1294.640	1729	.749		
Total	1718.802	1731			
Corrected Total	1718.504	1730			

R Squared = .247 (Adjusted R Squared = .246)

Parameter Estimates

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

					95% Confidence Interval	
Parameter	B	Std. Error	T	Sig.	Lower Bound	Upper Bound
Intercept	.012	.021	.572	.568	-.029	.053
attitudes	.495	.021	23.792	.000	.454	.535

Model 2: Attitudes & EE

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	39.086(a)	2	19.543	30.368	.000
Intercept	.860	1	.860	1.336	.249
Attitudes	39.086	1	39.086	60.736	.000
EE	.006	1	.006	.009	.925
Error	111.977	174	.644		
Total	154.252	177			
Corrected Total	151.063	176			

R Squared = .259 (Adjusted R Squared = .250)

Parameter Estimates

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

					95% Confidence Interval	
Parameter	B	Std. Error	T	Sig.	Lower Bound	Upper Bound
Intercept	-.114	.099	-1.156	.249	-.309	.081
attitudes	.442	.057	7.793	.000	.330	.554
EE	.012	.125	.094	.925	-.234	.258

Model 3 – Attitude & Percent over 55th Percentile in Math

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	25.531(a)	2	12.765	17.950	.000
Intercept	.069	1	.069	.097	.756
Attitudes	25.507	1	25.507	35.866	.000
math_pct	.025	1	.025	.035	.851
Error	86.761	122	.711		
Total	113.742	125			
Corrected Total	112.292	124			

R Squared = .227 (Adjusted R Squared = .215)

Parameter Estimates

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

Parameter	B	Std. Error	T	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	-.072	.231	-.312	.756	-.530	.386
attitudes	.429	.072	5.989	.000	.287	.571
math_pct	-.076	.404	-.188	.851	-.876	.724

Model 3 - Attitude & Percent over 55th Percentile in Reading

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	28.347(a)	2	14.174	21.743	.000
Intercept	1.062	1	1.062	1.629	.204
Attitudes	26.641	1	26.641	40.868	.000
rdg_pct	1.400	1	1.400	2.148	.145
Error	77.573	119	.652		
Total	106.796	122			
Corrected Total	105.921	121			

R Squared = .268 (Adjusted R Squared = .255)

Parameter Estimates

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

Parameter	B	Std. Error	T	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Intercept	.358	.281	1.276	.204	-.197	.913
attitudes	.458	.072	6.393	.000	.316	.599
rdg_pct	-.705	.481	-1.466	.145	-1.658	.248

Full Model - Math

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	26.514(a)	2	13.257	18.855	.000
Intercept	.053	1	.053	.075	.784
Attitudes	25.199	1	25.199	35.841	.000
math_ee	1.009	1	1.009	1.435	.233
Error	85.778	122	.703		
Total	113.742	125			
Corrected Total	112.292	124			

R Squared = .236 (Adjusted R Squared = .224)

Parameter Estimates - Math

Dependent Variable: BEHAVIOR factor score 1 for analysis 1

					95% Confidence Interval	
Parameter	B	Std. Error	T	Sig.	Lower Bound	Upper Bound
Intercept	-.028	.103	-.274	.784	-.233	.176
attitudes	.427	.071	5.987	.000	.286	.568
math_ee	-.180	.150	-1.198	.233	-.478	.118

Appendix H: Hard-to-Serve School Eligibility (2008-09 to Present School Year)

The employee must work at a hard-to-serve school. The hard-to-serve designation is based on the percentage of free and reduced price lunches served. The calculation is as of October 31 of the prior school year (October count).

Guideline FRL percentages:

- 87+% Elementary
- 85+% Middle School
- 75+% High School.
- All "Provision II" schools
- All "Alternative" schools

Employee must be actively enrolled in ProComp and be in a status of active with benefits (AB), leave with pay (LP), leave summer pay/benefits (LR), or FMLA leave (LF status in Lawson, which is currently unused), with a current or pending CDE license or authorization at the time of serving. Approved authorizations include:

1. A1 - Auth Adjunct Teacher
2. A10 - Temporary Teacher
3. A12 - JROTC Authorization (A new rule will be created for ROTC)
4. A2 - Intern
5. A3SN - Emergency Special Services Authorization
6. A3TN - Emergency Teacher Authorization
7. A6SN - Type VI Auth, Temp Special Services
8. A6TN - Type VI Auth, Temp Teacher
9. A7 - Authorization: Teacher in Residence
10. AISN - Authorization: Interim Special Services
11. AITN - Authorization: Interim Teacher
12. ATL - Alternative Teacher License
13. ATLW - Alternative Teacher License Waiver
14. INSL - Initial Special Services License
15. INTL - Initial Teacher License
16. LIFE - Life License
17. PFSL - Professional Special Services License
18. PFSM - Professional Special Services Lic-Master
19. PFTL - Professional Teacher License
20. PFTM - Professional Teacher Lic-Master
21. PVSL - Provisional Special Services License
22. PVTL - Provisional Teacher License
23. TIR - Teacher in Residence

24. TFA - Teach for America
25. DTF - Denver Teaching Fellows
26. ATLWD - District issued license replacing DTF and TFA.

Pending Licenses:

1. ALT APPL: Alternative License Applied - CDE
2. EMERG-APPL: Emergency Authorization Applied - CDE
3. REGLICAPPL: Regula License Applied - CDE
4. TIR APPL: TIR Authorization Applied - CDE

- Teacher must be assigned to a school on the Transition Team approved list of Hard-to-Serve schools during time of service. Note: Transition Team approves the list of Hard-to-Serve Schools by January of the previous year for the contract year to come. For example, the Transition Team approved the list of Hard-to-Serve schools in January of 2008 for the 2008/2009 contract year.
- Employee must serve at least one full day in that month in a qualified status at a Hard-to-Serve school to qualify for the Hard-to-Serve incentive for that month.
  Output F-005: If an employee does not serve the minimum one day in any given month, they do not qualify for the Hard-to-Serve incentive that month. Payout will be denied. Employee must be enrolled in ProComp and in a status of active with benefits (AB), leave with pay (LP), leave summer pay/benefits (LR), or FMLA leave (LF status in Lawson, which is currently unused) and have an active CDE license or approved authorization at the time of payout to qualify for payout.
- Employees that are in qualified status and successfully serve in a month during September through April qualify for payment for that month.
- Employees that are in qualified status and successfully serve in the month of May are eligible for payment in May. In addition, if they continue to remain actively enrolled in ProComp and are in AB, LF, LP or LR status, they will also receive payment over the summer months (June - August). (The employee does not have to have a current CDE license or approved authorization over the summer months to qualify for payout during the summer months.)
- Compensation is given in the same month served if the employee is identified by that months' payroll deadline. If the employee is in qualified status and successfully serves in any given month, but is not identified by that month's Payroll deadline, the employee is eligible for retroactive payment for that month to be paid in the first available payroll cycle.
- Employees that are in qualified status and successfully serve in the month of May are eligible for payment in May. In addition, if they continue to remain actively enrolled in ProComp and are in AB, LF, LP or LR status, they will also receive payment over the summer months (June - August). (The employee does not have to have a current CDE license or approved authorization over the summer months to qualify for payout during the summer months.)

- Employees will receive a percentage of the incentive that equals their FTE status at time of payout.
- The maximum payout is 1.0 FTE.
- The FTE status at time of payout multiplied by the employee's "distribution percentage" at designated Hard-to-Serve schools determines the percentage of the incentive the employee will receive, regardless of FTE at time of service.For example, an employee with 1.0 FTE who allocates time equally between two schools, but only one of the schools is designated Hard to Serve, will receive half of the total amount of the Hard to Serve incentive.
- If the employee has been **RIB'd** to another school that is not listed as Hard-to-Serve through no fault of their own at any point during the contract year, they may be eligible to continue to receive a Hard-to-Serve incentive.

A. Payment Eligibility

- Employees that are in qualified status and successfully serve during September through May are eligible for payment for that month.
- Employees that are in qualified status and successfully serve in the month of May are eligible for payment during June, July and August if they continue to remain actively enrolled in ProComp and are in a status of active with benefits (AB), leave with pay (LP), leave summer pay/benefits (LR), or FMLA leave (LF status in Lawson, which is currently unused).
- Compensation is given in the same month served if the employee is identified by that month's payroll deadline. If the employee is in qualified status and successfully serves in any given month, but is not identified by that month's Payroll deadline, the employee is eligible for retroactive payment for that month to be paid in the first available payroll cycle.

B. Payment Amount

- Hard-to-Serve incentives are paid out monthly as 1/12 of the annual amount.
- The maximum payout for this incentive is 1.0 FTE multiplied by the incentive amount.
- Your payment is prorated by the FTE at the school served. For example, an employee with 1.0 FTE who allocates time equally between two schools, but only one of the schools is designated Hard to Serve, will receive half of the total amount of the Hard to Serve incentive.

Source: ProComp Website. Retrieved February 1, 2010 from: http://denverprocomp.dpsk12.org/eligibility/hard_schools

Appendix I: Hard-to-Serve School Eligibility (2006-07 to 2007-08 School Years)

Technical Description of Data Analysis to Identify Hard-to-Serve Schools for 2007-08.
(December 14, 2006, Jennifer Sharp Silverstein)

Step 1: Data Sources

Hard to Serve requires the following information:

- School level ELL status
- School level FRL status
- Percent of students on Medicaid
- Percent of students in Center Programs
- Individual student crime level data, aggregated to school level

An excel file with school level data was created using 2006 October count data. The file include the above variables, except the crime data. The crime data used SPSS and was based on the student primary residence and attached to student's school.

All alternative schools and charter schools were excluded from the analysis.

Step 2: Replicating crime index

The crime data had the following variables:

1. Homicide
2. **Sexual Assault**
3. **Robbery**
4. **Aggravated Assault**
5. Burglary
6. Larceny
7. Theft from motor vehicle
8. Auto Theft
9. Arson
10. **Other Assault**
11. Forgery
12. **Criminal Mischief**
13. **Weapons**
14. **Other Sexual Offenses**
15. **Drug Abuse**
16. **Against family (domestic)**

17. Disorderly

18. Other

Using previous year's approach, only bolded variables were used in a factor analysis. Factor analysis, using principal components analysis, yielded two factors with eigenvalues exceeding 1. The first factor accounted for 50.9% of the variance. The first factor component weights for 2006 and 2007 are provided in Table 1. The first factor score was used for each student and identified as the crime factor. The student level scores were aggregated to the school level and the school's mean score became the crime factor for that school.

Table 1: Principal Component Matrix for Crime Analysis 2006 and 2007

	Component	
	2006	2007
Sexual Assault	.229	.578
Robbery	.780	.737
Aggravated Assault	.840	.874
Other Assault	.874	.865
Criminal Mischief	.856	.833
Weapons	.646	.625
Other Sex Offenses	.803	.575
Drug Abuse	.573	.735
Against Family (Domestic)	.627	.562
Disorderly Conduct	.717	.686

Extraction Method: Principal Component Analysis.

Step 3: School level database

In SPSS, a school level data base was created. Five variables were used (ELL percent, FRL percent, Crime factor, Medicaid percent, and Center Programs) in the analysis. Z-values were calculated and saved across all schools. Descriptive statistics for these are shown in Table 2.

Table 2: Descriptive Statistics for Five School-level Variables

	N	Minimum	Maximum	Mean	Std. Deviation
FRL percent	122	6.16	96.79	66.58	23.113
Center Program percent	122	.00	22.00	2.85	3.968
ELL percent	122	1.16	72.46	30.81	21.693
Medicaid percent	122	2.90	61.10	27.45	11.484
Crime Factor	122	-.99	2.72	.07	.635

Step 4: Weighted Average of School Level Variables

The z-scores were given equal weight across the schools. Schools were then sorted by education level. Then the schools were sorted by the average z-score of the 5 components. Using DCTA staff member counts, the number of staff members were expressed as percentages and cumulated from the highest to lowest average z-score. The schools staffed by the first 15% of DCTA members, starting with the highest average score, were identified as Hard to Serve. Following the same procedure as previous years, a school was included if the preceding school failed to reach a cumulative 15%, even if the difference was small. For example, if a previous school had a cumulative percent of 14.9%, the next school would be included regardless of whether the cumulative percentage significantly exceeded 15%.

Step 5: 2007 Hard to Serve Schools
Below are the 2007 Hard to Serve schools by education level. Schools that have been identified as Hard to Serve in previous years have been included on the list, along with their status. The rule is that schools are identified as Hard to Serve for three years. If a school is identified as Hard to Serve in consecutive years, the school's three years start over (Ashley Elementary).

Elementary

School Name	2005	2006	2007	Status
WHITEMAN ELEMENTARY SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
FAIRVIEW ELEMENTARY SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
WYMAN ELEMENTARY SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
GILPIN K-8 SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
BARRETT ELEMENTARY SCHOOL			**X**	**Year 1 of 3**
DEL PUEBLO ELEMENTARY SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
REMINGTON ELEMENTARY SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
MONTCLAIR ELEMENTARY SCHOOL		**X**	**X**	**Year 1 of 3**
FAIRMONT K-8 SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
MITCHELL ELEMENTARY SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
GREENLEE K-8 SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
VALDEZ ELEMENTARY SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
CHELTENHAM ELEMENTARY SCHOOL	**X**	**X**	**X**	**Year 1 of 3**
ASHLEY ELEMENTARY SCHOOL		**X**	**X**	**Year 1 of 3**
PHILIPS ELEMENTARY SCHOOL			**X**	**Year 1 of 3**

SCHENCK ELEMENTARY SCHOOL			**X**	**Year 1 of 3**
COLUMBIAN ELEMENTARY SCHOOL		**X**		**Year 2 of 3**
GARDEN PLACE ELEMENTARY SCHOOL	**X**			**Year 3 of 3**
CASTRO ELEMENTARY SCHOOL	**X**			**Year 3 of 3**
HARRINGTON ELEMENTARY SCHOOL	**X**			**Year 3 of 3**
BRYANT WEBSTER K-8 SCHOOL		**X**		**Year 2 of 3**

Middle

School Name	2005	2006	2007	Status
HORACE MANN MIDDLE SCHOOL		**X**	**X**	**Year 1 of 3**
PLACE MIDDLE SCHOOL			**X**	**Year 1 of 3**
SMILEY MIDDLE SCHOOL			**X**	**Year 1 of 3**
BRUCE RANDOLPH SCHOOL	**X**		**X**	**Year 1 of 3**
MERRILL MIDDLE SCHOOL	X			Year 3 of 3
HILL MIDDLE SCHOOL	X	X		Year 2 of 3
RISHEL MIDDLE SCHOOL		X		Year 2 of 3
LAKE MIDDLE SCHOOL	X			Year 3 of 3

High

School Name	2005	2006	2007	Status
WEST HIGH SCHOOL		**X**	**X**	**Year 1 of 3**
NORTH HIGH SCHOOL	**X**		**X**	**Year 1 of 3**
ABRAHAM LINCOLN HIGH SCHOOL	X			Year 3 of 3

Source: Market Incentives Work Group Report. Presented to the ProComp Transition Team, 2005.