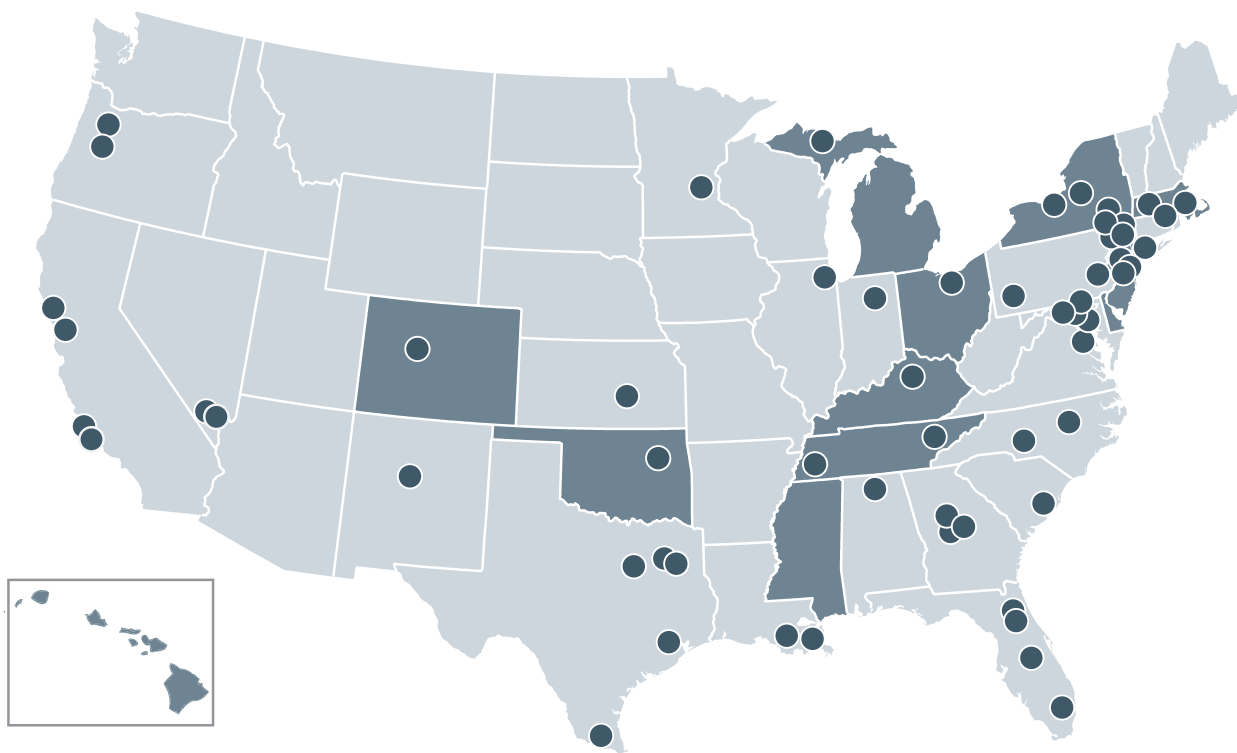# STRATEGIC DATA PROJECT

SDP HUMAN CAPITAL DIAGNOSTIC

Colorado Department of Education

January 2015

THE STRATEGIC DATA PROJECT (SDP)

Since 2008, SDP has partnered with 75 school districts, charter school networks, state agencies, and nonprofit organizations to bring high-quality research methods and data analysis to bear on strategic management and policy decisions. Our mission is to transform the use of data in education to improve student achievement.

Part of the Center for Education Policy Research at Harvard University, SDP was formed on two fundamental premises:

1. Policy and management decisions can directly influence schools' and teachers' ability to improve student achievement.

2. Valid and reliable data analysis significantly improves the quality of decision making.

SDP's theory of action is that if we are able to bring together the right people, assemble the right data, and perform the right analysis, we can help leaders make better decisions—ultimately improving student achievement significantly.

To make this happen, SDP pursues three strategies:

1. building a network of top-notch data strategists who serve as fellows for two years with our partners (e.g., school district, charter management organization, nonprofit, or state education agency);

2. conducting rigorous diagnostic analyses of teacher effectiveness and college-going success using agency data; and

3. disseminating our tools, methods, and lessons learned to the education sector broadly.

The project is supported by the Bill & Melinda Gates Foundation.

SDP HUMAN CAPITAL DIAGNOSTIC

Introduction

Over the course of a calendar year (from spring 2013 to spring 2014), the Strategic Data Project (SDP) collaborated with the Colorado Department of Education (CDE) and the Colorado Education Initiative (CEI)[1] to conduct SDP's Human Capital Diagnostic—a series of high-leverage, policy-relevant analyses related to the state's educator workforce. SDP's Human Capital Diagnostic investigates questions on five critical topics related to teachers and teacher effectiveness: recruitment, placement, development, evaluation, and retention.

Our focus on the teacher workforce—or, in other words, on an education agency's human capital—stems from the fundamental role that public school teachers play in educating students. There is widespread consensus among practitioners, researchers, and policymakers that teachers are the most important school-based factor that affects students' academic growth and development.[2] Recent research suggests that effective teachers may influence students' longer-term outcomes, such as their labor market earnings many years later.[3] Given teachers' critical role in influencing students' growth, it is imperative that education agencies be well informed about the functioning of their human capital systems.

SDP's Human Capital Diagnostic was a timely research collaboration given Colorado's evolving policies related to teachers and teacher evaluation. Three years prior to this collaboration, the state legislature passed Senate Bill 10-191, which required annual evaluations of principals and teachers and reformed aspects of the state's tenure policies. At roughly the same time, CEI received a multimillion-dollar grant from the Bill & Melinda Gates Foundation to launch the Colorado Integration Project—a collaboration between 13 school districts across the state to integrate standards, assessment, and evaluations.[4] As part of this work, participating districts began collecting teacher-student data links,[5] which are at the core of teacher evaluation systems and research about how to strengthen teaching and learning.

SDP's Human Capital Diagnostic served to inform this broader work. The diagnostic analyses related to teacher recruitment, placement, and retention provided the state with contextual information about its human capital workforce that can inform its implementation of new teacher evaluation policies. In addition to the standard diagnostic analyses, SDP researchers also conducted analyses related to students' growth within schools, given the role that students' growth will play in educators'

evaluations. This summary report highlights the key findings from our Human Capital Diagnostic. We have also authored a series of shorter memos that focus on individual key findings of particular relevance given the state's policy context.

Recruitment

To gather foundational descriptive information about the Colorado teacher workforce, we examined broad patterns in hiring over two recent school years (2010–11 and 2011–12). During this timeframe, we found that roughly 10% of teachers were new hires. However, schools with higher concentrations of students from disadvantaged backgrounds hired more new teachers than schools with lower concentrations of students from disadvantaged backgrounds. As Figure 1 demonstrates, in schools across the state where 65% of students or more qualified for free or reduced-price lunch (FRL), 14% of teachers were new hires during the 2010–11 and 2011–12 school years. By comparison, in schools where less than 40% of students qualified for FRL, including schools with very low concentrations of poverty, slightly less than 9% of teachers were new hires, on average. We examined hiring patterns in schools with different levels of student achievement and found similar results—in schools with lower average achievement, a greater percentage of teachers are new hires than in schools with higher average achievement.

Figure 1. Proportion of Colorado Teachers Who Are New Hires by School Free- and Reduced-Lunch Category Statewide
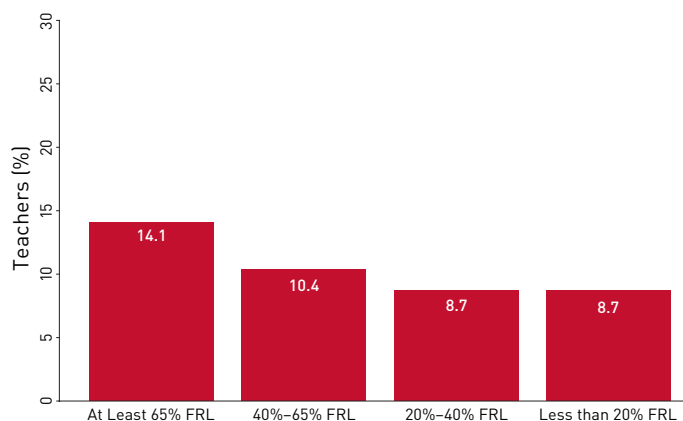
Note. Sample includes teachers with teacher job codes in comprehensive, vocational, charter, and magnet schools, with 95,435 teacher years and 53,523 unique teachers in the 20010–11 to 2011–12 school years. All data from state administrative records.

Placement

A common finding in teacher effectiveness research is that novice teachers are generally less successful at raising students' achievement than their more experienced peers.[6] Thus, placing students who are academically behind with novice teachers is likely to exacerbate achievement gaps among student groups. SDP's placement analysis examines the extent to which students with lower prior achievement are disproportionately placed with first-year teachers. We conducted this analysis using student-teacher data links and student achievement data for students in Grades 4 through 8 in four recent school years (2008–09 through 2011–12). Due to data limitations, we were only able to perform these analyses for 11 districts that were part of the Colorado Integration Project: Eagle County Schools, Thompson School District, and the nine districts that comprise the San Juan BOCES (Archuleta, Bayfield, Dolores, Dolores County (Dove Creek), Durango, Ignacio, Mancos, Montezuma-Cortez, and Silverton).

As Figure 2 depicts, across schools in these districts, we found that first-year teachers were assigned students whose prior achievement was 0.22 standard deviations below that of students in the classrooms of teachers who were not novices.[7] However, this placement pattern across the 11 Integration districts seems to be the result of lower-achieving students attending schools with less-experienced teachers. When we conducted the same analysis within schools in these districts, we did not see statistically significant differences in the average prior achievement of students in novice and non-novice teachers' classrooms.

Figure 2. Difference in Average Prior Math Performance of Colorado Students Assigned to Newly Hired Novices Compared to All Other Teachers: Integration Project Districts
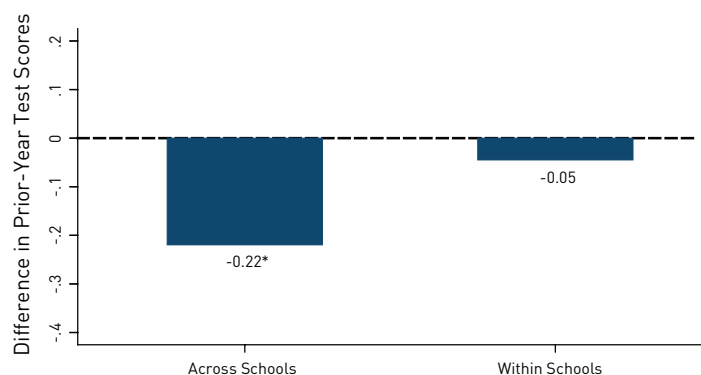
*Significantly different from zero, at the 95% confidence level.
Note. Sample includes comprehensive and magnet school teachers with teacher job codes and their students in Grades 4 through 8 with prior-year test scores in the 2008–09 through 2011–12 school years in the 11 Integration Project Districts participating in the study. This includes 778 teacher years, 28,584 student years, 347 unique teachers, and 14,530 unique students. Test scores are normalized to have an average of zero and a standard deviation of one, and are shown in standard deviation units. All data are from state administrative records.

Development

A vast body of research has found that teachers' effectiveness is related to their years of experience and increases most rapidly during their early year on the job.[8] Modeling the relationship between teachers' experience and effectiveness—or the "returns to experience"—is complex, and different analytical approaches produce somewhat different pictures about whether teachers' effectiveness continues to increase or levels off in the later years of their careers.[9]

Generally speaking, like much of the research literature, SDP's human capital research with various partners has found that teachers' effectiveness increases most rapidly during their early years on the job and that teacher experience is more predictive of effectiveness than whether a teacher has an advanced degree.[10]

Using data from the 11 Colorado Integration Project districts for whom complete data were available, we investigated the relationship between teachers' effectiveness, their years of experience, and whether they possessed an advanced degree. As Figure 3 reveals, we found a positive relationship between effectiveness and experience for both math and English language arts teachers. Non-novice math teachers raised their students' performance on math assessments by about 0.09 standard deviations more than newly hired novice math teachers. Non-novice ELA teachers raised their students' performance about 0.07 standard deviations more than their novice ELA teacher peers. These gains represent approximately 2.5 months of additional learning.[11] By comparison, our results show that math and ELA teachers with advanced degrees were not more effective at raising student achievement than their peers with bachelors' degrees.

Figure 3. Teacher Impacts on Colorado Student Achievement: Integration Project Districts
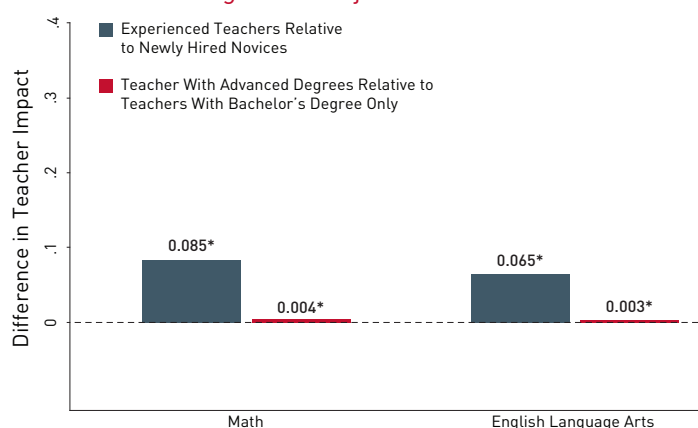
*Significantly different from zero, at the 95% confidence level.
Note. Sample includes comprehensive, magnet, and charter school teachers with teacher job codes and their students in grades 4 through 8 with prior-year test scores in the 2008–09 through 2011–12 school years in the 11 Integration Project Districts participating in the study. Difference in teacher impact for teachers with advanced degrees relative to teachers with bachelor's degree only calculated using a sample of 751 math teacher years, 828 ELA teacher years, 336 unique math teachers, and 360 ELA teachers. All data are from state administrative records.

Working with the Colorado Integration Project Districts

As part of our diagnostic collaboration with Colorado, SDP conducted many of our human capital and college-going[12] analyses at the district level for the 11 Colorado Integration Project districts with which we worked closely during this partnership. Our district-specific analyses examined rates of hiring across schools; the relationship between hiring and schools' average achievement; the distribution of effectiveness among elementary and middle school math and English language arts teachers; the extent to which teachers' current and prior value-added scores were related; rates of teacher turnover across schools; and the relationship between turnover and schools' average student achievement.
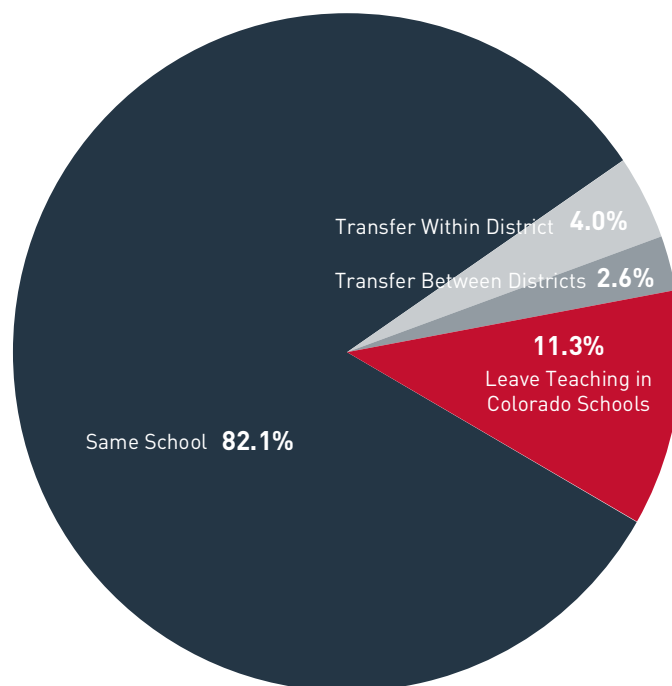
We presented the findings from these district-specific analyses via individual webinars with key leaders in each district. We have not featured findings from these analyses here due to concerns about small sample sizes. However, this work warrants brief mention given that it constituted a substantial portion of the collaboration and may have a large impact on informing district practice. During this work, one participating district chose to feature findings from these analyses in a district Race to the Top grant application. To make analyses possible in another participating district, an SDP Strategic Data Fellow compiled teacher-student data links for the first time in the district's history. During the webinar of the findings, district leadership expressed their enthusiasm for what the analyses revealed and their interest in working with the SDP Fellows to ensure that these analyses were extended and repeated in the future.

Retention

Analyses of teacher retention and turnover can help state education agencies identify patterns in teachers' movements into, across, and out of districts in the state, which can, in turn, inform numerous human capital policies related to teacher preparation, hiring, and retention. Using state administrative data from two recent school years, we examined the percentage of teachers who were teaching during the 2009–10 school year and either stayed in their same school, transferred to a different school within the same district, transferred between Colorado school districts, or left teaching in the Colorado public school system. As Figure 4 reveals, approximately 82% of teachers remained teaching in the same school between the 2009–10 and 2010–11 school years. During this same timeframe, 4% of teachers transferred to another school in the same district, roughly 3% of teachers transferred between Colorado public school districts, and about 11% left teaching in the Colorado public schools.

Similar to our findings about teacher hiring, we found that schools with higher concentrations of students from low-income backgrounds were associated with higher

Figure 4. Average Colorado Statewide Teacher Retention Rates

Transfer Within District **4.0%**

Transfer Between Districts **2.6%**

11.3%
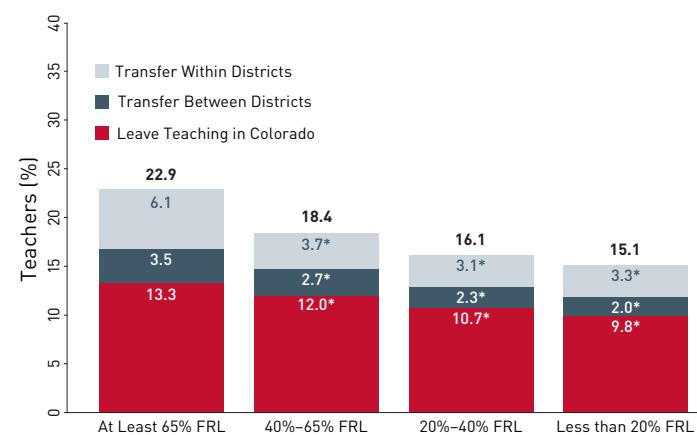Leave Teaching in Colorado Schools

Same School **82.1%**

Note. Sample includes teachers with teacher job codes in comprehensive, vocational, charter, and magnet schools, with 96,744 teacher years and 54,015 unique teachers in the 2009–10 to 2010–11 school years. Retention analysis are based on one-year retention rates. All data are from state administrative records.

rates of turnover. As Figure 5 depicts, in schools where 65% or more students qualified for FRL, approximately 6% of teachers transferred to another school in their same district, 3.5% transferred to a school in another district, and 13% left teaching in a Colorado public school. By comparison, in schools where less than 20% of students qualified for FRL, 3% of teachers transferred to another school in their same district, 2% transferred to a school in another district, and less than 10% left teaching in a Colorado public school.

Figure 5. Average Statewide Teacher Turnover in Colorado by School Poverty Category

*Significantly different from the At Least 65% FRL value, at the 95% confidence level.
Note. Sample includes teachers with teacher job codes in comprehensive, vocational, charter, and magnet schools, with 95,596 teacher years and 53,947 unique teachers in the 2009–10 to 2010–11 school years. Retention analysis are based on one-year retention rates. All data from state administrative records.

School Growth

As an extension of the Human Capital Diagnostic work, key leaders in CDE and CEI requested that SDP researchers investigate analyses related to the growth in performance of Colorado schools, as measured by schools' median growth percentiles (MGPs). As part of the state's reform of its teacher evaluation system, Colorado now requires that 50% of both teachers' and principals' evaluations must be based on growth in student learning. Colorado allows districts flexibility in deciding the details of how to measure student growth for use in educator evaluations, and median growth percentiles (MGPs) are one viable option. Further, MGPs are the growth metric that the state uses for school and district accountability purposes. Senior leaders in CDE and CEI asked that SDP researchers conduct exploratory analyses to investigate the relationship between schools' MGPs and (1) the size (i.e., student enrollment) of the school, (2) the percentage of students qualifying for FRL in a school, and (3) the principal's years of experience. Generally speaking, these analyses were intended to help Colorado policymakers consider the implications of human capital policies and practices on principals.

The key findings from these analyses were as follows:

- Smaller schools are more likely to have particularly high or particularly low MGPs than larger schools. Larger schools, by comparison, are more likely to have MGPs clustered around the average across schools in the state. This is unsurprising given that MGPs in small schools are based on fewer students and thus less precisely estimated than in larger schools.

- There is a slight negative relationship between schools' MGP and the percentage of students qualifying for FRL. In other words, schools with higher concentrations of students who qualify for FRL are associated with slightly lower MGPs than schools with lower concentrations of FRL students.

- Principals with more experience tend to work in schools with higher MGPs. There is some evidence that schools' MGPs rise as principals gain experience within schools.
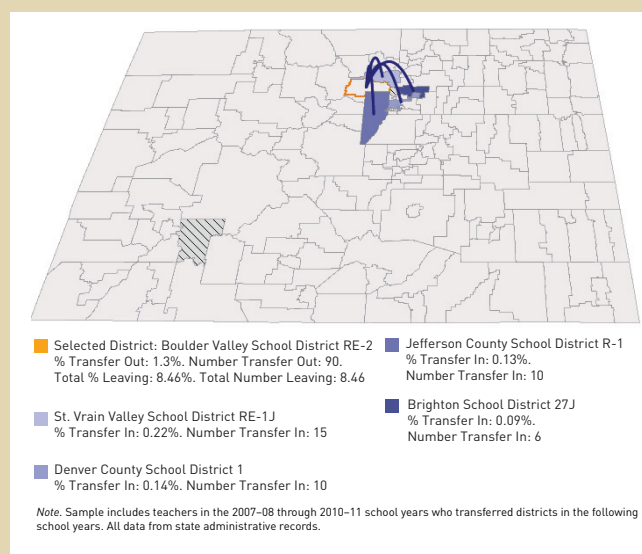
Piloting a New Web-Based Turnover Tool

In addition to these standard diagnostic analyses, SDP researchers used the state's human resources data from four school years (2007–08 through 2010–11) to create an interactive, web-based map that allows users to examine teacher mobility across particular districts in the state. The tool consists of an aerial map of Colorado that is segmented according to the boundaries of public school districts. Clicking on a particular district reveals a variety of information about the district's patterns of teacher mobility and turnover, including

- the percentage and number of teachers in the selected district who transferred out of the district during the period of observation,

- the percentage and number of teachers in the selected district who left teaching in the Colorado public school system during this same timeframe, and

- the four districts to which the greatest number of teachers in the selected district transferred. These receiving districts are also highlighted, and information about the number of teachers who transferred into each are displayed. (See Figure 6.)

This tool can also present similar information about the number, percentage, and originating districts of teachers who transfer into a selected school district. The features and statistics are the same as those described above, but with information about transfers in rather than transfers out.

In creating these tools, SDP envisions a number of potential uses. First, district administrators in districts with many schools can use the tool to gather

Figure 6. Colorado Teacher Transfer-Out Patterns

Selected District: Boulder Valley School District RE-2
% Transfer Out: 1.3%. Number Transfer Out: 90.
Total % Leaving: 8.46%. Total Number Leaving: 8.46

St. Vrain Valley School District RE-1J
% Transfer In: 0.22%. Number Transfer In: 15

Denver County School District 1
% Transfer In: 0.14%. Number Transfer In: 10

Jefferson County School District R-1
% Transfer In: 0.13%.
Number Transfer In: 10

Brighton School District 27J
% Transfer In: 0.09%.
Number Transfer In: 6

Note. Sample includes teachers in the 2007–08 through 2010–11 school years who transferred districts in the following school years. All data from state administrative records.

important summary information about the sources of current teacher supply. Similarly, in summarizing information about where their departing teachers go, district administrators gain important information about the appeal of their district relative to others nearby. This information might prompt important policy discussions about compensation, benefits, professional development offerings, etc. On a macro level, state administrators and policymakers can use the tool to investigate how patterns of mobility differ across different geographic regions, which might in turn lead to new policies aimed at either promoting certain patterns of teacher transfer (e.g., incentivizing teachers to transfer into districts with increasing enrollment, changing student populations, etc.) or reducing patterns that appear problematic.

Conclusions and Next Steps

SDP presented the findings from these analyses to key leaders from CDE and CEI over the course of the 2013–14 school year. In addition, to help strengthen the analytical capacity within both organizations, SDP held several training sessions to walk CDE and CEI analysts through the process for creating the analysis files and generating the statistical models on which these results are based. Finally, SDP transferred these analysis files and the associated programming code back to CDE, so that CDE and CEI analysts could conduct related analyses in the future.

 In the coming months and year, leadership at CDE and CEI intends to draw on the results from these analyses to inform several related initiatives that the state is developing and launching. For example, CDE is in the process of providing districts, schools, and the general public with reports of educators' experience and effectiveness aggregated at the school and district levels. CDE intends that recipients will use these reports to track which schools and districts have the most experienced and effective educators as well as identify where there might be gaps.

Related to teacher quality and retention, the state has launched the Quality Teacher Recruitment Grant Program, which provides funds to attract teachers to districts with historic recruitment shortages. The initiatives launched with these funds will be evaluated to determine whether they are successful in raising teacher quality and retention.

Given the close alignment between Colorado's current policy initiatives and the analyses that guided this diagnostic research collaboration, there will be multiple opportunities to use the data and evidence described here to help inform the state's ongoing work related to teacher recruitment, placement, development, and retention.

Endnotes

[1] The Colorado Education Initiative was formerly called the Colorado Legacy Foundation.

[2] e.g., Rivkin, Hanushek, & Kain, (2005); Wright, Horn, & Sanders, (1997).

[3] Chetty, Friedman, & Rockoff, (2011).

[4] See http://www.coloradoedinitiative.org/our-work/educator-effectiveness/colorado-integration-project/

[5] It should be noted that some of the integration grant districts, such as Eagle County, have been collecting teacher-student data links prior to this initiative.

[6] e.g., Rivkin, Hanushek, & Kain, (2005); Rockoff, (2004). For examples of SDP's research on teacher effectiveness with other agencies, see http://www.gse.harvard.edu/sdp/diagnostics/published-findings.php

[7] Roughly the equivalent of six fewer months of mathematics learning.

[8] Rice, (2010); Clotfelter, Ladd & Vigdor, (2007a); Harris & Sass (2007); Kane, Rockoff & Staiger, (2006).

[9] Rice, (2010); Kraft & Papay, (2013).

[10] For examples, see http://cepr.harvard.edu/sdp/diagnostics/published-findings.php

[11] Hill, Bloom, Black, & Lipsey, (2008).

[12] Strategic Data Project, (2014).

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