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Growing Together: *Professional Learning Communities at Work®* Generates Achievement Gains in Arkansas

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Growing Together: *Professional Learning Communities at Work®* Generates Achievement Gains in Arkansas

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Abstract

Professional learning communities (PLCs) are a teacher collaboration and professional development strategy that is widely used in public schools in the United States and beyond. PLCs have the potential to improve instruction and student learning through structured, ongoing, job-embedded staff collaboration. However, many schools find it challenging to implement the features of PLCs effectively. The Arkansas Division of Elementary and Secondary Education (DESE) invested in three years of intensive supports for schools to build high-functioning PLCs using Solution Tree's *Professional Learning Communities at Work® (PLC at Work®)* model. This study evaluates the effectiveness of Solution Tree's supports on student English language arts (ELA) and math achievement tests in Arkansas.

The study used a two-stage matching process to establish treatment and comparison groups combined with a difference-in-differences model to estimate treatment effects. It found that within 19 months (i.e., by the state testing period in the second year of implementation) the model had positive impacts on math achievement test scores (0.083 standard deviations, $p = 0.014$) and no effects on ELA achievement test scores.

The findings are relevant for schools considering or actively using PLCs to improve collaboration, teaching, and learning. The study also describes areas for further research, including replication in different contexts and experimental studies.

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Introduction

Effective teaching is critical for students' success (Coleman, 1966; Goldhaber, 2007; Hanushek & Rivkin, 2012; Kane & Staiger, 2008), and effective teacher collaboration has been shown to have a strong positive influence on students' academic progress (Branch et al., 2012, 2013; Chiang et al., 2014; Clifford et al., 2012; Dhuey & Smith, 2018; Dutta & Sahney, 2016). High-performing educators have also been linked to substantial long-term economic benefits for students and, by extension, for the communities in which students ultimately live and contribute (Chetty et al., 2014; Hanushek, 2011).

Acknowledging these strong connections between educator expertise and student outcomes, education leaders and policymakers frequently concentrate their efforts on improving the efficacy of the educator workforce through hiring and retaining effective teachers. While these initiatives are important, they impact only a fraction of the educator workforce. In contrast, effective school- or districtwide professional development has the potential to benefit all educators—and by extension, all students—within a system.

Effective schoolwide professional development for educators is often difficult to choose and implement, however. The field is crowded with options, and evidence of program effectiveness is sparse. Where rigorous evidence supports professional learning options, it is often narrowly focused on certain student groups, grade levels, and content areas, and options with complementary professional learning support for school leaders are rare (Darling-Hammond et al., 2017). Education leaders have few objective references to help them determine how well a program may fit in their local context.

Professional learning communities (PLCs) have the potential to meet the need for effective schoolwide professional development. PLCs can encompass many features of effective professional development, including a focus on active learning strategies and collaboration, explicit modeling of effective practice, expert coaching, and opportunities for feedback and reflection (Darling-Hammond et al., 2017). PLCs are already a common strategy for instructional improvement in U.S. public schools, yet there is little empirical evidence to help education leaders identify and apply PLC best practices that lead to positive student outcomes.

This study contributes to the limited body of evidence on the effectiveness of PLCs implemented across the spectrum of grade levels and content areas in K–12 schools. Specifically, it evaluates the effectiveness of Solution Tree's implementation of *Professional Learning Communities at Work*® (*PLC at Work*®) in Arkansas on student achievement in English language arts (ELA) and math. The study constitutes the first large-scale evaluation of the effects of a PLC initiative on student achievement. Further, it is the first evaluation of the impact of the widely used DuFour and Eaker model of PLCs—implemented by Solution Tree as *PLC at Work* in Arkansas—on student achievement (DuFour, 2004; DuFour, DuFour, Eaker, & Many, 2016).

The study is based on statewide data that include diverse communities and groups of students. This enabled investigations of the initiative's overall effect on student achievement as well as its effects on student groups, including those that are historically underserved by education systems. The current study complements a rigorous implementation study that measured schools' fidelity to the *PLC at Work* model and quantified progress on desired improvements in educator collaboration and instruction practices (Torres et al., 2020). That study confirmed that all schools in the study sample (Cohort 1), which began the initiative during the 2017/18 school year, had implemented *PLC at Work* with fidelity by the end of the third year, with the exception of one school that dropped out of the program after two years.

This study employed a two-stage matching process followed by a difference-in-differences framework to estimate the impact of *PLC at Work* in Arkansas on ELA and math state achievement tests. It found that the initiative had a positive effect on math achievement test scores (0.083 standard deviations, $p = 0.014$) and no effect on ELA achievement test scores after less than two years of the three-year intervention. Positive effects were observed for several student groups, and no significant negative effects were found for any student group.

The study findings are relevant for school, district, and state education leaders who are reviewing schoolwide professional development options. It is especially pertinent for administrators who are considering or actively implementing PLCs. This study's findings imply that the coaching Solution Tree provided through the *PLC at Work* initiative can yield early benefits for math student achievement after less than two years of the three-year initiative. Moreover, the intervention included schools with a wide range of characteristics and students from varied backgrounds. The diverse sample suggests that the results may apply to a variety of school contexts beyond the study sample.

Future research should evaluate the effects of the full three-year intervention, which were not possible due to the cancellation of state assessments during the 2019/20 school year as a result of the COVID-19 pandemic. Other opportunities for future research include replication studies for other cohorts of schools in the Arkansas initiative and for schools in other states. Additionally, a study that employs random selection of schools could validate these promising results.

This report begins with a brief review of the literature related to the connection between PLCs and student outcomes. This is followed by a summary of the *PLC at Work* model in Arkansas. The report continues with descriptions of the study's data, methods, and results and concludes with a discussion of implications, contributions to the literature, and opportunities for continued research.

Literature review

PLCs gained popularity in the 1990s as a collaborative alternative to the traditional model of teaching and curriculum development in which teachers work in isolation and are individually responsible for the success of the students in their classrooms (Feger & Arruda, 2008; Flinders, 1988; Hamos et al., 2009; Scribner et al., 1999; Williams et al., 2012). Today, PLCs are one of the most common forms of collaborative teacher professional development in K–12 public schools in the United States. When implemented well, PLCs promote sustained collaboration focused on designing and sharing curricula and instructional strategies, as well as collective responsibility for the success of all students (DuFour et al., 2016).

Consistent with effective adult learning practices, PLCs provide collaborative, ongoing, job-embedded professional learning (see, for example, Darling-Hammond & Bartz-Snoden, 2005; Darling-Hammond et al., 2009; Johnson & Taylor, 2006; Kolb, 1984; Yoon et al., 2007). Participating in a PLC, according to several studies, can increase teacher confidence and self-efficacy to improve student learning (Bandura, 1977; Clary et al., 2012; Tschannen-Moran & Hoy, 2007). Likewise, participation in PLCs may improve early career teachers' resilience and persistence in the profession (Kitching et al., 2009).

PLCs often have a positive association with student outcomes, according to a large body of research. Many studies have observed positive correlations with student achievement test scores (Berry et al., 2005; Burns et al., 2018; Capraro et al., 2016; Huggins et al., 2011; Jackl & Lougée, 2012; Louis & Marks, 1998; Ratts et al., 2015; Saunders et al., 2009; Sigurðardóttir, 2010; Williams, 2013). One study provides quasi-experimental evidence that PLCs have a positive impact on student achievement gains when implemented well and alongside project-based learning (Capraro et al., 2016). Additional studies found positive associations with student engagement and attitudes (Chou, 2011; Dix & Cawkwell, 2011; McLaughlin & Talbert, 2006; Owen, 2015).

Many of the studies cited above emphasize that the benefits of PLCs only occur when they are well implemented. This presents a challenge for school leaders. Implementing PLCs well typically requires changes to staff norms and expectations, school schedules, and curriculum development and pacing. These changes can present steep learning curves and logistical barriers. Furthermore, research indicates that without a clear set of definitions and expectations for the PLC process, collective buy-in from teachers and staff members, and support from administration, schools are likely to abandon the model (Munoz & Branham, 2016; Sims & Penny, 2015; Talbert, 2010). The *PLC at Work* initiative in Arkansas seeks to help schools surmount these implementation obstacles and maximize the benefits to student learning that PLCs are designed to achieve.

Background of *PLC at Work* in Arkansas

The *PLC at Work* model, as conceptualized by Richard Dufour and Robert Eaker, is an "ongoing process in which educators work collaboratively in recurring cycles of inquiry and action research to achieve better results for the students they serve" (DuFour et al., 2016, p. 10). Solution Tree has delivered professional learning resources and services based on the *PLC at Work* model on a national scale since 1998 (Solution Tree, 2021). Its work in Arkansas, which is under evaluation in this study, amplified its *PLC at Work* model to new levels of customization and scope.

For *PLC at Work* in Arkansas, Solution Tree allotted up to 50 days per year of on-site coaching and training to each Cohort 1 school. They also paired a four- or five-member team of skilled associates—a lead associate and associates in the areas of leadership, math, assessment, and literacy—with each school according to its needs, which were identified through an assessment conducted at the beginning of the first year. Solution Tree selected all associates using a rigorous review process that required candidates to have extensive experience and a proven record of success with implementing the *PLC at Work* model (Solution Tree, 2021).

In practice, schools accommodated between 38 and 47 days of on-site coaching each year (figure 1). Schools supplemented on-site coaching with off-site training for key faculty members and leaders at *PLC at Work* workshops, on-demand virtual coaching from Solution Tree associates, and full access to Solution Tree's Global PD online library of *PLC at Work* resources and trainings.

Figure 1. On average, Solution Tree delivered 38 to 47 days of on-site coaching and training to each Cohort 1 school

Year 1
- 21 days of embedded coaching
- 14 days of content coaching for teachers
- 7 days of leadership coaching
- 2 days of all-staff training

Year 2
- 12 days of embedded coaching
- 14 days of content coaching for teachers
- 6 days of leadership coaching
- 4 days of sustainability coaching
- 2 days of celebration

Year 3
- 12–16 days of embedded coaching
- 17–25 days of content coaching for teachers
- 4 days of sustainability coaching
- 2 days of celebration

Source: Reproduced from Torres et al., 2020.

Solution Tree's tailored coaching, training, and resources supported schools' implementation of effective schoolwide teacher collaboration. The *PLC at Work* model promotes distributed leadership via a guiding coalition that includes school administrators and representatives from collaborative teams, which typically include teachers from the same grade level or content area. Educators focused on three guiding principles—or three big ideas— to enhance teaching and learning through the collaboration (DuFour et al., 2016, p. 11-12):

- **Focus on learning.** The principle that the fundamental purpose of the school is to ensure that all students learn at high levels.
- **Collaborative culture and collective responsibility.** The principle that educators must work collaboratively and take collective responsibility for the success of all students in their school.
- **A results orientation**. The principle that educators will use evidence of student learning to inform and improve their professional practice and to meet the needs of individual students who need interventions or extensions.

The implementation evaluation that accompanies the present study found that Cohort 1 schools achieved full implementation of the core aspects of *PLC at Work* (Torres et al., 2020).[1] The evaluation's findings suggest that achieving full implementation of the *PLC at Work* model

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[1] This study excludes the school that dropped out of Cohort 1 after Year 2.

within three years yields expected improvements in collaboration, instructional practices, and student learning.

Notably, all Cohort 1 schools reported positive changes in instructional practices, including improvements in identifying and providing appropriate interventions for students who need extra help and extensions for students who are ready for advanced material. Likewise, educators reported that the implementation of *PLC at Work* improved their school's culture of collaboration and collective responsibility for ensuring all students learn at high levels. Nearly all educators in Cohort 1 schools agreed that their collaborative teams practiced effective communication, teachers trusted one another, teachers practiced collective efficacy and responsibility for student learning, and teachers believed that all students could learn at high levels.

The present study tests whether the implementation progress Cohort 1 schools made—less than two years into the three-year intervention—resulted in benefits to student learning. Specifically, the study intends to provide empirical evidence of the effectiveness of the *PLC at Work* model as implemented in Arkansas on students' ELA and math state achievement test scores. Two questions guided the study:

1. What is the impact of *PLC at Work* on student achievement in ELA and math?
2. How do the impacts of *PLC at Work* vary among students with different background characteristics, including gender, race/ethnicity, and eligibility for free or reduced-price lunch, English learner, and special education programs?

Method

Data

The Arkansas Division of Elementary and Secondary Education (DESE) provided statewide student-level data from the 2009/10 to 2018/19 school years. This included records for ACT Aspire state achievement test scores, student demographic background characteristics, federal program enrollment, discipline, and attendance. The data also included school-level information, including geographic location in the state. Finally, DESE provided information about educators, including years of experience, content area and grade levels taught, and degrees earned. The study used longitudinal data from 2009/10 through 2018/19 to observe whether students had ever enrolled in a federal program, including English learner, free or reduced-price lunch, and/or special education programs. The analysis otherwise leveraged state data from the 2016/17 through 2018/19 school years to assess *PLC at Work*'s impact on student achievement test scores.

Measures

The study's primary dependent variables included state-administered ACT Aspire ELA and math achievement test scores. Arkansas administered the ACT Aspire assessment annually during the study period (2016/17–2018/19). ELA and math ACT Aspire scores were standardized within grade level and school year among the entire population of students who took the assessment.

The primary independent variable is a binary indicator equal to 1 if a student was enrolled in a *PLC at Work* Cohort 1 school in 2017/18—the first year of the intervention—and 0 otherwise. Analyses included several covariates measured at baseline (i.e., in 2016/17). At the student level, these included ELA and math ACT Aspire scores, standardized among all test takers in the state within grade level to have a mean of 0 and a standard deviation of 1; grade level; gender; race/ethnicity; and a vector of binary indicators for federal program enrollment (i.e., English learner, free or reduced-price lunch, special education, and gifted and talented programs) set to 1 if the student had ever been enrolled in the program and 0 otherwise; as well as binary indicators for whether the student had been suspended or expelled and whether the student was chronically absent. Chronic absence was defined as being absent—whether excused or unexcused—for 18 or more days in the school year (i.e., at least 10 percent of school days).

School-level covariates included school average baseline ELA and math ACT Aspire scores; geographic region (Northwest, Northeast, Central, Southeast, and Southwest Arkansas); school enrollment; a binary indicator for whether the school was in a district that contained a *PLC at Work* school; the percentage of teachers in their first year of teaching; percentages of students who were white; and percentages of students who were ever enrolled in federal programs, including English learner, free or reduced-price lunch, and special education programs. Additionally, the school's propensity score for selection into the treatment—derived from the first stage of the matching process—was included in models.

Sample

DESE selected treatment schools through a competitive application process. All state-funded schools were invited to apply. The state received 86 applicants and selected 10 schools and one small school district in Cohort 1.[2] DESE reviewed applications using a set of criteria and

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[2] The schools included Bragg Elementary School, Ballman Elementary School, Douglas MacArthur Junior High School, Greenbrier Eastside Elementary School, Frank Mitchell Intermediate School, Monticello Middle School, Morrilton Intermediate School, Rogers High School, Joe T. Robinson Middle School, Spradling Elementary, and all schools in Prescott School District. Prescott School District included two schools—an elementary and a secondary school—in the baseline year and the first year of implementation. The district divided its students into three schools—an elementary, junior high, and high school—in the outcome year (2018/19). The study matched schools based on the configuration during the baseline year. Student outcomes were measured for those who attended a *PLC at Work* school in 2017/18 and their matched peers regardless of where they attended school in 2018/19.

selected schools from each of the five geographic regions of the state. The selected Cohort 1 schools had many similar characteristics to all other schools in the state, on average, particularly with respect to proficiency on state assessments (table 1).

Table 1. Characteristics of PLC at Work *project schools compared to other schools in Arkansas, 2016/17*

	Project schools (N = 12)	All other schools in Arkansas (N = 898)
Student enrollment characteristics		
Average number of students enrolled	623	461*
Number of students per teacher	13	12*
Percentage of students who are Black	23%	20%
Percentage of students who are Latinx	16%	10%**
Percentage of students who are white	57%	66%
Percentage of students who are eligible for free or reduced-price lunch	64%	64%
Percentage of students who are English learners	11%	6%*
Percentage of students with special needs	12%	12%
Percentage of students who met or exceeded standards on the 2016/17 ACT Aspire assessments		
English language arts	52%	51%
Mathematics	51%	47%
Science	41%	40%

* $p < 0.05$, ** $p < 0.01$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

One Cohort 1 school dropped out of the program after completing the second year. This school and its students who were enrolled in the first implementation year remained in the analytic sample. Additionally, because this school exited in the third intervention year, it received the same intervention as all other Cohort 1 schools during the study period.

Analytic sample exclusions

The study authors excluded certain schools that received partial treatment from the comparison sample prior to conducting the matching process used to establish baseline equivalency. These included 14 schools selected for Cohort 2 of *PLC at Work,* which began receiving intervention services in the 2018/19 school year. Additionally, five schools not in a *PLC at Work* cohort sent several school leaders and faculty members—typically the principal, other school or district administrators, and teacher leaders—to participate in more than five days of onsite or offsite *PLC at Work* training during the study period. To avoid comparing one *PLC at Work* intervention with another, these schools were excluded from the sample prior to matching.

The treatment sample included all students who were enrolled in a Cohort 1 school during the first year of the program (2017/18) and had a baseline (2016/17) state achievement test score. Students who were enrolled in a Cohort 1 school at any time during the first implementation year were included in the study sample, regardless of their attendance at other schools during the first two years of implementation. There were two exceptions: Students were excluded from the sample if they attended a Cohort 2 school or a school that was dropped for participating in more than five days of *PLC at Work* training.

Attrition

Students who joined Cohort 1 or comparison schools after the first intervention year (2017/18) were not admitted into the sample. Prior to the treatment, the total number of students was 2,756 in the treatment schools and 46,703 in the control schools. Some treatment and comparison group students left Arkansas or otherwise did not take the state ELA or math assessment in the second intervention year (2018/19). This included 131 matched treatment students and 2,398 matched comparison students (the analytic approach section describes the matching process). These students were removed from the sample and baseline equivalence was retested and confirmed with the trimmed sample. The overall attrition rate was 5.1 percent, and the differential attrition rate was 0.4 percent. This level of attrition falls below a cautious threshold for potential bias (i.e., attrition is likely exogenous to the intervention and levels are acceptable for the study design).

Sample characteristics

Arkansas administered the ACT Aspire summative assessment to public school students in grades 3–10 for the duration of the study period. Therefore, most students with ELA and math assessment scores at the end of the second year of the intervention were in grades 3–8 in the baseline year (99.9 percent). The other 0.1 percent of students were in grade 9 in the baseline year and repeated either grade 9 or 10 during the study period.

Table 2. Analytic sample and state average (all schools), 2016/17

	Analytic sample		
Characteristic	*PLC at Work* Cohort 1 schools (N = 2,626)	Comparison schools (N = 44,320)	All schools (N = 218,382)
Demographics			
Female	47.6% (50.0)	47.3% (49.9)	48.8% (50.0)
Black	22.4% (41.7)	21.8% (41.3)	19.3% (39.5)
Latinx	17.8% (38.3)	18.0% (38.5)	13.7% (34.4)
white	55.1% (49.7)	55.5% (49.7)	60.1% (49.0)
Federal program eligibility			
English learner	14.9% (35.6)	15.1% (35.8)	11.4% (31.8)
Free or reduced-price lunch	85.6% (35.1)	85.3% (35.4)	62.1% (48.5)
Special education	16.8% (37.4)	16.8% (37.4)	13.0% (33.6)
Achievement			
Average baseline ACT Aspire English language	-0.010 (0.955)	0.013 (0.956)	0.002 (0.999)

arts scores (standardized)			
Average baseline ACT Aspire math scores (standardized)	0.031 (0.951)	0.031 (0.952)	0.007 (0.997)

Note: Standard deviations are in parentheses. Analytic sample values are weighted. See appendix A for baseline equivalency details. Sample for all schools includes students in grades 3–8 in 2016/17 who were not missing ELA and math assessment scores.

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Analytic approach

Our approach to estimating the effects of *PLC at Work* on student achievement included a two-stage matching process to establish baseline equivalency between treatment and comparison groups, followed by the use of a hierarchical intent-to-treat (ITT) model to estimate the main effects of the model. This was followed by group analyses to estimate the effect of *PLC at Work* on students from different backgrounds. We repeated the ITT model used to estimate the main effect among samples limited to students with a common background characteristic (i.e., the same gender, race/ethnicity, or federal program eligibility status).

Matching approach

This study established baseline equivalency between treatment and comparison groups through a two-stage matching process (figure 2). The approach is grounded in theory, reflecting the program's selection and implementation processes. It begins at the school level, where the intervention occurred and continues at the student level, where the intervention aims to impact outcomes.

Figure 2. Two-stage sampling design and associated statistical matching stages to establish baseline equivalency between PLC at Work *Cohort 1 and comparison schools*
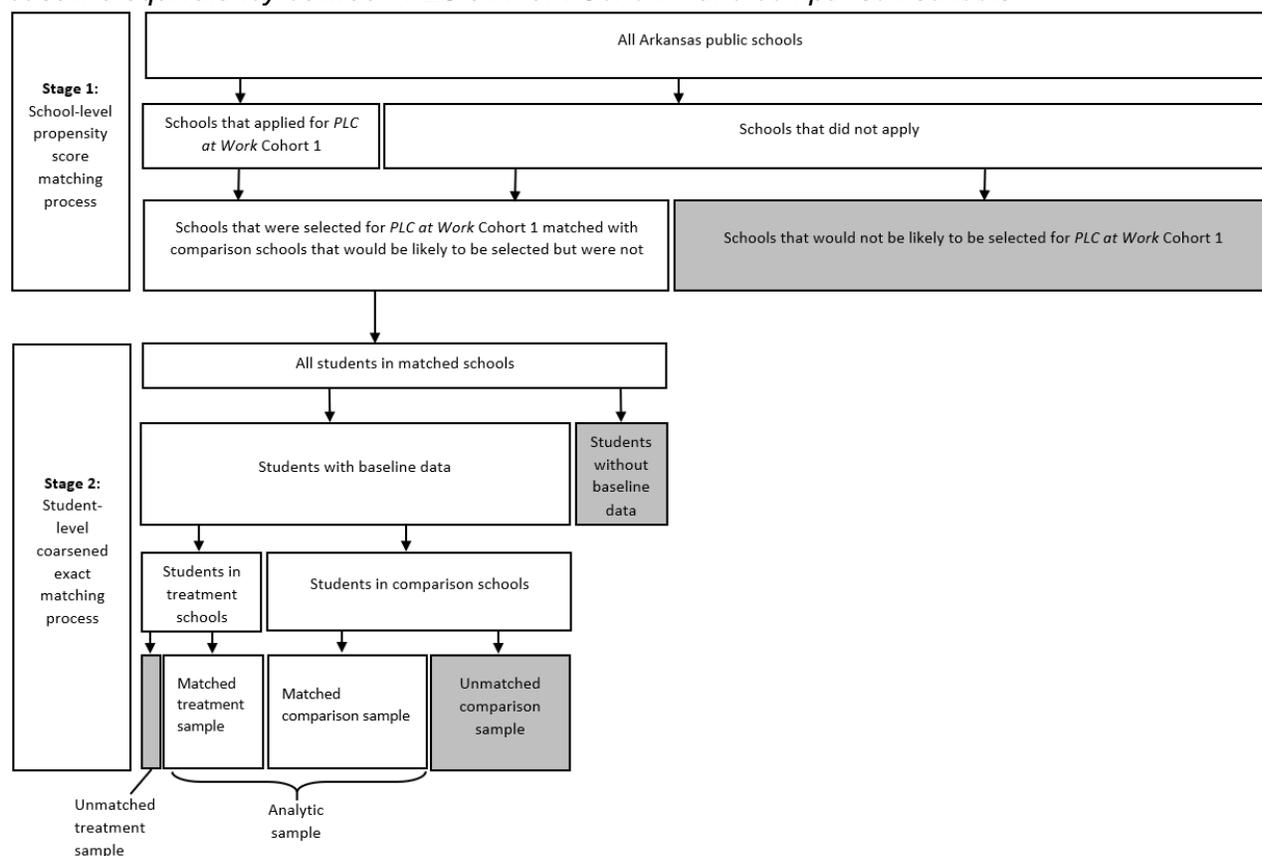
Source: Authors' illustration.

In the first stage, propensity score matching (PSM) established a comparison group for treatment schools (Rosenbaum & Rubin, 1983). When DESE selected Cohort 1 schools through a competitive application process, it used criteria to select schools rather than a random sampling procedure. Because the time between the notice for application and the selection process was short—two months before the intervention began— the study team acknowledged that information gaps may have discouraged some schools from filing an application. As a result, the study team chose to include all schools in the comparison sample prior to matching.

The estimated propensity score, $p(x_j)$, for school j ($j = 1,…,969$) is the conditional probability of being selected for *PLC at Work* Cohort 1 given a set of baseline year covariates, X_j, including the number of students enrolled; average ELA and math achievement test scores; the percentage of students who are male; percentages of students who are Black, Latinx, or white; percentages of students who were ever eligible for federal programs, including English learner, free or reduced-price lunch, or special education services; the average years of teacher experience; and the percentage of beginning teachers (equation 1).

$$p(x_j) = \Pr(PLCatWork_j = 1 | X_j) \tag{1}$$

Upon completion of the PSM procedure, the sample was restricted to comparison schools with common support. That is, comparison schools in the matched sample had propensity scores that fell within the range of propensity scores for the treatment group (0.007 to 0.039). The trimmed sample included all 12 *PLC at Work* Cohort 1 schools and 645 comparison schools with no remaining significant differences across groups (see table A1 in appendix A for detailed results).

After restricting the sample to treatment and comparison schools with common support, the study team employed a coarsened exact matching (CEM) process to pair students within treatment schools to peers within the matched set of comparison schools (Iacus et al., 2012). CEM "coarsens" each variable through recoding so that substantively indistinguishable values are grouped and assigned the same numerical value. Then, an "exact matching" algorithm is applied to the coarsened data to identify matches and remove unmatched units. Finally, the coarsened data are discarded, and the original values of the matched data are retained for analysis. Specifically, the CEM algorithm creates a set of strata, each with the same coarsened values of $X = (X_1, X_2, ..., X_k)$, a k-dimensional dataset, where each X_j is a column vector of observed values of pretreatment variable j for n sample observations. Units in strata that contain at least one treated and one comparison student are retained while all other strata are removed from the sample. Each matched student, i, in stratum s is assigned a weight:

$$w_i = \begin{cases} 1, & i \in T^s \\ \frac{m_C}{m_T} \cdot \frac{m_T^s}{m_C^s}, & i \in C^s \end{cases} \quad (2)$$

where T^s represents the treated students in stratum s, m_T^s is the number of treated students in each stratum, and m_T is the number of matched students in the treatment group. Similarly, for comparison students, C^s, m_C^s is the number of treated students in each stratum and m_C is the number of matched students in the treatment group (Iacus et al., 2012).

The matching algorithm includes several pretreatment characteristics that are associated with student achievement. These include binary indicators for the male gender; each racial/ethnic group; grade level in the baseline year; and whether a student was ever an English learner, ever eligible for free or reduced-price lunch, or ever eligible for special education. In addition, baseline ELA and math achievement test scores were stratified into seven groups based on the sample distribution to minimize the range of scores within each stratum.

After matching, there were no significant differences between treatment and comparison groups. In addition, Hedges' g and Cox tests confirmed that each difference between treatment and comparison groups had effect sizes smaller than 0.25 (see table A2 in appendix A for baseline equivalency details).

Benefits of a two-stage matching process

The two-stage matching process aligns with the *PLC at Work* selection process and implementation design—it is a school-level intervention focused on improving student learning

and engagement. In addition, conducting a two-stage matching process helps mitigate limitations of a single approach. Matching at the school level is appropriate because *PLC at Work* is a schoolwide intervention, with services delivered to school administrators, teachers, and other school staff members. Further, PSM is an appropriate approach to pair treatment and comparison schools since schools needed to apply to become part of Cohort 1. The propensity for a school to apply to become part of Cohort 1 may be correlated with its characteristics.

However, PSM is vulnerable to omitted variable bias and modeling constraints. There is a trade-off between using all available variables that could potentially be correlated with the outcome and the number of degrees of freedom available in the model. Moreover, each variable brings unique distributional properties that often require transformation and sample trimming to achieve normality before matching. Each variable in the model mediates the influence of others on the outcome, complicating the path to achieving and interpreting baseline equivalence. The study team mitigated these challenges by limiting the PSM model to variables with the strongest correlation to the outcome at the risk of increasing omitted variable bias.

Student-level matching helps correct for some of the limitations of school-level matching. The average characteristics of a school, which were used to match treatment and comparison schools, often fall short when representing the diversity of student background and academic characteristics within schools. Unlike PSM, CEM does not rely on modeling assumptions about the data generation process beyond the usual ignorability assumptions. The method performs as well or better in its ability to reduce imbalance between treatment groups, model dependents, estimation error, bias, variance, and mean square error (Iacus et al., 2012).

Estimation model

After creating a comparison group through this two-stage matching process, the study team used an ITT difference-in-differences model to measure the difference in treatment and comparison group achievement test score growth between the baseline year and the second year of the intervention. The ITT model assigns outcomes to students based on enrollment in a treatment or comparison school in the first year of the intervention (2017/18), regardless of where they attended school in year 2 (2018/19). The ITT model is shown in equation 3:

$$Y_{ij} = \alpha + PLCatWork_{ij} + \boldsymbol{X}_{ij} + \boldsymbol{\delta}_j + u_j + \varepsilon_{ij} \qquad (3)$$

where Y_{ij} is either the ELA or math ACT Aspire score in the outcome year (2018/19) for student i in school j; *PLCatWork* is an indicator for whether student i was enrolled in a *PLC at Work* school; $\boldsymbol{X}_{ij}$ is a vector of baseline (2016/17) student-level covariates, including ELA and math ACT Aspire scores; binary indicators for whether student i was chronically absent, suspended or expelled; male gender; ever eligible for English learner services, free or reduced-price lunch, or special education services; and for each racial/ethnic group (American Indian or Alaska Native, Asian, Black, Latinx, Native Hawaiian or Pacific Islander, and multiracial relative to white students); and a categorical variable for grade level. $\boldsymbol{\delta}_{j,}$ is a set of school characteristics, including the propensity score determined through the matching process; binary indicators for

each geographic region of the state (Northwest, Northeast, Central, and Southwest relative to Southeast); a binary indicator for whether the school belonged to a district that contained a *PLC at Work* school; and baseline characteristics include the percentages of students eligible for English learner services, free or reduced-price lunch, or special education services, the number of students enrolled, white students, school average baseline math and ELA score, and the percentage of beginning teachers. u_j is a school random effect and ε_{ij}, represents residual error.

Group analysis

Finally, the study team tested the efficacy of the *PLC at Work* model in Arkansas for groups of students from different backgrounds. For each group analysis, the authors limited the sample to a group of students with a characteristic in common, such as gender, race/ethnicity, and federal program enrollment status (table 3). The ITT model in equation 3 estimated group-level effects, omitting variables that result in multicollinearity. For example, racial/ethnic indicators were omitted when the analytic sample was limited to Black students.

After limiting the sample, certain groups—often those with smaller populations—were no longer statistically equivalent across all characteristics used to match treatment and comparison students. At times, these student groups were statistically equivalent after the PSM procedure and prior to the CEM procedure. For comparison, Appendix C presents results using only the first stage of the matching procedure. A couple of student groups were not statistically equivalent either before or after the CEM procedure. In these cases, differences among groups are correlational and will need further study to validate them.

Table 3. Student groups included in group analyses and statistical equivalency between PLC at Work and comparison students before and after two-stage matching procedure

Category	Groups	Statistical equivalency between *PLC at Work* and comparison students achieved	
		After first stage (PSM)	After second stage (CEM)
Gender	• Males	X	X
	• Females	X	
Race/ethnicity	• Black students	X	
	• Latinx students		
	• White students	X	X
Federal program eligibility status	• Students who were ever eligible for free or reduced-price lunch	X	X
	• Students who were never eligible for free or reduced-price lunch	X	
	• Students who were current English learners		
	• Students who were former English learners		
	• Students who were never English learners	X	X
	• Students who were ever eligible for special education services	X	
	• Students who were never eligible for special education services	X	X

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Results

The analysis found that students in *PLC at Work* schools accelerated their growth on math achievement tests relative to their matched peers. Specifically, students in *PLC at Work* schools had 0.083 standard deviations higher growth on ACT Aspire math assessments between 2016/17 and 2018/19 than that of their matched peers ($p = 0.014$). This statistically significant result equates to moving a student at the 50th percentile of math scores to the 53rd percentile.

Meanwhile, students in *PLC at Work* schools had about the same growth on ELA achievement tests as their matched peers. They had growth on ELA assessments between 2016/17 and 2018/19 that was 0.018 standard deviations higher than that of their matched peers ($p = 0.648$).

Student group effects of *PLC at Work* on student achievement

The *PLC at Work* model emphasizes the importance that all students learn and grow. For this reason, it is useful to examine group-level treatment effects and assess whether the initiative's impact varies among student groups. Many student groups in *PLC at Work* schools demonstrated higher growth than their matched peers in comparison schools, particularly in math (table 4). Several student groups recorded growth on achievement tests at about the same rate in *PLC at Work* and comparison schools. This was especially true in ELA, where only one group—those never eligible for free or reduced-price lunch—showed a significantly higher growth rate for *PLC at Work* students relative to their matched peers (0.100 standard deviations, $p = 0.035$).

In contrast, several student groups in *PLC at Work* schools achieved higher math achievement growth between 2016/17 and 2018/19 than that of their peers in comparison schools by statistically significant margins. Some of these groups represent students who are traditionally underserved in education systems. These include students who were ever eligible for free or reduced-price lunch. In addition, female students, male students, white students, students who were never eligible for English learner services, and students who were never eligible for special education services in *PLC at Work* schools achieved significantly higher growth than that of their peers in comparison schools. All other student groups grew at about the same rate as their matched peers.

In ELA, students in *PLC at Work* schools grew at about the same rates as their peers in comparison schools for the most part. Only students who were never eligible for free or reduced-price lunch in *PLC at Work* schools grew at significantly higher rates than their matched peers in comparison schools. Black students had higher growth than their peers, and this growth was close to statistical significance ($p = 0.056$).

Table 4. PLC at Work's *contributions to student achievement growth from baseline (2016/17) in Cohort 1 schools in the second year of implementation (2018/19)*

Student group	Treatment effect (standard error)	
	ELA	Math
All students (main treatment effect)	0.018	0.083*
	(0.039)	(0.034)
Gender		
Female students	0.035	0.068*
	(0.037)	(0.031)
Male students	0.010	0.090*
	(0.047)	(0.041)
Race/ethnicity		
Black students	0.070	0.019
	(0.037)	(0.041)
Hispanic/Latino students	-0.053	0.042
	(0.042)	(0.071)
White students	0.035	0.118**
	(0.034)	(0.039)
Federal program status		
Students who were current English learners	-0.055	0.017
	(0.054)	(0.066)
Students who were former English learners	-0.034	0.152*
	(0.049)	(0.076)
Students never identified as English learners	0.038	0.090**
	(0.036)	(0.029)
Students ever eligible for free or reduced-price lunch	0.018	0.085*
	(0.037)	(0.034)
Students never eligible free or reduced-price lunch	0.100*	0.036
	(0.048)	(0.061)
Students ever identified for special education	0.026	0.013
	(0.070)	(0.055)
Never identified for special education	0.020	0.089**
	(0.040)	(0.031)

* $p < 0.05$, ** $p < 0.01$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17–2018/19.

Discussion

This study shows that the *PLC at Work* model—accompanied by expert support to implement it—can positively influence student achievement in math without negative effects in ELA two years into the three-year intervention. This study's large, statewide sample represented diverse sets of school contexts and student backgrounds. This suggests that the results may extend to schools beyond those included in the study. The findings may inspire school leaders pursuing the benefits of PLCs to commit to the tenets of the *PLC at Work* model and advocate for support to implement it.

The *PLC at Work* model posits that implementing the core components of the process with fidelity can support improvements in instructional practices and, by extension, in student learning. This study confirms that the theory has merit. Nevertheless, systems change inevitably takes time, careful planning, flexibility to adapt to challenges, and patience to manage setbacks.

A commitment to the *PLC at Work* model requires a "focused, organized, and consistent school in which leaders and teachers collaborate, make evidence-based decisions, understand that the student is the top priority, communicate effectively, and are involved in trusting relationships" (Spiller & Power, 2019, p.1). To get there, Cohort 1 schools needed to dismantle old routines and foster new ways of learning and growing together. This worked best when districts supported the transition by providing school leaders the flexibility to change schedules to protect collaboration time, identify essential standards to prioritize in the curricula, and distribute school leadership (Torres et al., 2020). By extension, building and sustaining the *PLC at Work* model relied on creating opportunities for teacher leadership and strengthening their leadership abilities (Torres et al., 2020).

Importantly, the *PLC at Work* schools included in this study received Solution Tree's comprehensive and customized support to implement the model. Indeed, this study evaluates the effectiveness of the *PLC at Work* model in concert with the coaching, training, and resources Solution Tree provided to smooth transitions to new norms and fortify the core components of the model in each school. Solution Tree associates helped schools navigate and overcome hurdles with consistent and open lines of communication and timely, ongoing coaching. They differentiated supports to fit each school's unique needs and provided hands-on training that empowered educators to learn by doing rather than simply telling them how to do it. In turn, many Cohort 1 school leaders and educators credited their early successes to the support Solution Tree provided (Torres et al., 2020).

Limitations and opportunities for future research

Several opportunities for future research surfaced from this study's promising findings of the *PLC at Work* model implemented in Arkansas. Foremost among them is the need for an evaluation of the full implementation of the three-year model. School closures due to the

COVID-19 pandemic interrupted state testing in the 2019/20 school year. This eliminated the possibility of evaluating the full three-year implementation of the *PLC at Work* intervention for Cohort 1. Replicating the study with a cohort of schools that received the full intervention should be done to confirm the results.

Furthermore, the study's results rely on quasi-experimental methods to establish a comparison group in the absence of random assignment of schools to treatment and control conditions. The two-stage matching process achieved baseline equivalency between treatment and comparison schools on several characteristics that are highly correlated with student outcomes; however, the study cannot guarantee the absence of bias.

One concern is that the sample is limited to the heterogeneity of students within the selected treatment schools. Matching identified peers with similar background characteristics among students in Cohort 1 schools. Nevertheless, these students may have idiosyncrasies that are unobservable or difficult to measure.

Additionally, it is not possible to match students in treatment and comparison schools on all factors that could influence the outcome. This is because they are either measured through proxies, such as tying motivation to succeed in school to baseline test scores; they are not available in existing datasets, such as family and community characteristics; or there are not a sufficient number of students in the comparison sample that can match to students in the treatment group on a large number of characteristics. A study in which schools are randomly selected to receive the intervention could mitigate some of the limitations of the present study.

Finally, there is value in studying variations of the *PLC at Work* model evaluated in this study. For example, evaluating the model in other states could reinforce the generalizability of the findings. There are further opportunities to evaluate variations on the model, such as providing additional or fewer implementation supports for longer and shorter periods of time or measuring the effectiveness of the model when schools implement it without support. Such evaluations could test the threshold for the intensity of supports that result in positive impacts on student achievement.

Overall, while much room exists for further evaluation, this study contributes important evidence to a limited body of research on the effectiveness of PLCs to improve student achievement. It suggests that the *PLC at Work* model—with support for implementation—can help schools begin to see improvements in student learning in just two years. Beyond student achievement, the accompanying implementation study (Torres et al., 2020) finds that school leadership and teacher efficacy improved with time for professional collaboration focused on instructional quality, inquiry, and helping all students succeed. Altogether, the promising results suggest the *PLC at Work* model, when implemented well, can be a fulcrum for improving instruction and student learning across widespread and diverse student groups and school contexts.

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Appendix A. Two-stage matching process results

This appendix provides details about the two-stage matching process this study used to achieve baseline equivalence between treatment and comparison groups. First, table A1 presents means, standard deviations, and effect size tests (Hedge's g) for balance equivalency before and after conducting propensity score matching among variables used during the matching procedure. Note that variables were standardized and transformed prior to matching to normalize distributions for treatment and comparison samples. The following table (A2) presents the same information for the student level, before and after the coarsened exact matching procedure. To ascertain effect sizes for the difference between treatment and comparison groups, Hedge's g tests were used for continuous variables and Cox's index tests were used for binary variables.

Table A1. Baseline means and standard deviations of treatment and comparison group school characteristics before and after the propensity score matching process

	Group									
	Unmatched					**Matched**				
	PLC at Work (N = 12 schools)		Comparison (N = 957 schools)			*PLC at Work* (N = 12 schools)		Comparison (N = 645 schools)		
Variables	Mean	S.D.	Mean	S.D.	Hedge's g	Mean	S.D.	Mean	S.D.	Hedge's g
School enrollment (standardized and log transformed)	0.625	0.736	0.757	0.655	0.200	0.631	0.708	0.624	0.499	0.014
Student demographics (standardized)										
Black students	0.113	0.604	−0.001	1.004	0.114	0.207	0.576	0.066	1.003	0.141
Latinx students (square root)	3.644	1.861	3.008	1.645	0.386	3.895	1.876	3.593	1.786	0.169
White students	−0.256	0.696	0.003	1.003	0.259	-0.415	0.631	-0.206	0.981	0.214
Male students	0.326	0.547	−0.004	1.004	0.330	0.329	0.577	0.266	0.639	0.098
Federal program eligibility (standardized)										
English learner	0.274	1.242	−0.003	0.997	0.277	0.389	1.298	0.259	1.128	0.115
Free or reduced-price lunch (reciprocal, cubed)	0.000006	0.000006	0.0000003	0.0000004	0.055	0.0000004	0.000005	0.0000005	0.000004	0.155
Special education	−0.049	0.531	0.001	1.005	0.049	-0.066	0.470	-0.035	0.683	0.046
Average ACT Aspire scores (standardized)										
English language arts (cubed)	−0.079	0.760	-0.006	4.842	0.015	−0.229	0.704	−0.199	2.545	0.012
Math	−0.003	0.577	0.0000003	1.004	0.003	−0.101	0.523	−0.002	0.903	0.110
Teacher experience (standardized)										
Average years of experience	0.105	0.866	−0.001	1.002	0.106	0.255	0.829	0.055	0.923	0.216
Percentage of beginning teachers	−0.180	0.881	0.002	1.002	0.182	−0.250	0.780	−0.174	0.808	0.095

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table A2. Baseline means and standard deviations of treatment and comparison group student characteristics before and after the coarsened exact matching process

	Group									
	Unmatched					Matched				
	PLC at Work (N =12 schools; 5,360 students)		Comparison (N=645 schools; 198,921 students)			*PLC at Work* (N = 87 schools; 2,625 students)		Comparison (N = 313 schools; 44,305 students)		
Variables	Mean	S.D.	Mean	S.D.	Hedge's g or Cox's index	Mean	S.D.	Mean	S.D.	Hedge's g or Cox's index
English language arts score (standardized)	-0.017	0.668	-0.027	0.668	0.016	-0.010	0.955	0.013	0.956	0.024
Math score (standardized)	0.030	0.675	0.018	0.662	0.018	0.031	0.951	0.031	0.952	0.001
Grade level	6.636	2.148	6.399	2.278	0.104	5.263	1.718	5.288	1.721	0.014
Ever eligible for English learner services	0.167	0.373	0.125	0.331	0.202	0.149	0.356	0.151	0.358	0.083
Ever eligible for free or reduced-price lunch	0.816	0.387	0.808	0.394	0.033	0.856	0.351	0.853	0.374	0.053
Ever eligible for special education services	0.184	0.388	0.191	0.393	0.028	0.168	0.374	0.168	0.413	0.161
Black	0.187	0.390	0.193	0.395	0.023	0.224	0.417	0.218	0.413	0.061
Latinx	0.194	0.395	0.147	0.354	0.200	0.178	0.383	0.180	0.385	0.107
White	0.566	0.496	0.593	0.491	0.066	0.551	0.497	0.555	0.497	0.141
Male	0.520	0.500	0.518	0.500	0.004	0.524	0.500	0.527	0.499	0.022

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table A3. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching and coarsened exact matching processes, by race/ethnicity

Group	Black			Latinx			White		
	PLC at Work (N = 43 schools; 588 students)	Comparison (N = 261 schools; 9,167 students)		*PLC at Work* (N = 29 schools; 467 students)	Comparison (N = 273 schools; 6,802 students)		*PLC at Work* (N = 59 schools; 1,450 students)	Comparison (N = 304 schools; 26,974 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	−0.378 (0.869)	−0.418 (0.780)	0.050	−0.098 (0.895)	−0.131 (0.709)	0.045	0.161 (0.966)	0.179 (0.898)	0.020
Math score (standardized)	−0.379 (0.836)	−0.465 (0.719)	0.118	−0.081 (0.886)	−0.106 (0.671)	0.038	0.237 (0.955)	0.195 (0.884)	0.047
Grade level	5.350 (1.494)	5.457 (1.637)	0.065	6.004 (1.974)	5.427 (1.730)	0.331	4.993 (1.649)	5.216 (1.686)	-0.132
Ever eligible for English learner services	0.002 (0.041)	0.000 (0.010)	1.665	0.788 (0.409)	0.844 (0.363)	0.227	0.000 (0.000)	0.000 (0.000)	0.000
Ever eligible for free or reduced-price lunch	0.983 (0.129)	0.994 (0.077)	0.638	0.985 (0.122)	0.997 (0.051)	1.058	0.757 (0.429)	0.750 (0.433)	0.023
Ever eligible for special education services	0.192 (0.394)	0.163 (0.369)	0.122	0.167 (0.373)	0.085 (0.279)	0.466	0.161 (0.367)	0.140 (0.347)	0.097
Male	0.495 (0.500)	0.495 (0.500)	0.001	0.550 (0.498)	0.539 (0.499)	0.028	0.524 (0.500)	0.518 (0.500)	0.015

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table A4. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching and coarsened exact matching processes, by English learner status

Group	Current English learner			Former English learner			Never English learner		
	PLC at Work (N = 23 schools; 264 students)	Comparison (N = 232 schools; 3.471 students)		*PLC at Work* (N = 15 schools; 127 students)	Comparison (N = 199 schools; 2,393 students)		*PLC at Work* (N = 84 schools; 2,234 students)	Comparison (N = 305 schools; 38,441 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	−0.406 (0.875)	−0.444 (0.684)	0.054	0.463 (0.673)	0.268 (0.534)	0.358	0.009 (0.960)	0.028 (0.895)	-0.021
Math score (standardized)	-0.346 (0.876)	-0.348 (0.635)	0.003	0.392 (0.740)	0.181 (0.605)	0.345	0.056 (0.956)	0.028 (0.881)	0.032
Grade level	6.508 (1.874)	5.732 (1.744)	0.442	5.654 (2.017)	5.195 (1.661)	0.273	5.096 (1.613)	5.260 (1.672)	0.098
Ever eligible for free or reduced-price lunch	0.992 (0.087)	0.999 (0.029)	1.319	1.000 (0.000)	1.000 (0.000)	0.000	0.832 (0.374)	0.821 (0.383)	0.043
Ever eligible for special education services	0.231 (0.422)	0.130 (0.337)	0.422	0.031 (0.175)	0.027 (0.161)	0.102	0.168 (0.374)	0.141 (0.348)	0.127
Black	0.004 (0.062)	0.000 (0.017)	1.563	0.000 (0.000)	0.000 (0.000)	0.000	0.263 (0.440)	0.238 (0.426)	0.079
Latinx	0.951 (0.217)	0.978 (0.145)	0.516	0.921 (0.270)	0.980 (0.142)	0.853	0.044 (0.206)	0.028 (0.164)	0.297
White	0.000 (0.000)	0.000 (0.000)	0.000	0.000 (0.000)	0.000 (0.000)	0.000	0.649 (0.477)	0.702 (0.458)	0.146
Male	0.561 (0.497)	0.575 (0.494)	0.036	0.551 (0.499)	0.481 (0.500)	0.172	0.517 (0.500)	0.511 (0.500)	0.016

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table A5. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching and coarsened exact matching processes, by gender

Group	Male			Female		
	PLC at Work (N = 64 schools; 1,373 students)	Comparison (N = 304 schools; 22,774 students)		*PLC at Work* (N = 57 schools; 1252 students)	Comparison (N = 295 schools; 21,531 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	-0.139 (0.969)	-0.162 (0.886)	0.025	0.130 (0.917)	0.180 (0.828)	0.060
Math score (standardized)	0.019 (0.992)	−0.029 (0.887)	0.054	0.045 (0.902)	0.044 (0.825)	0.002
Grade level	5.269 (1.750)	5.269 (1.693)	0.000	5.260 (1.681)	5.318 (1.670)	0.035
Ever eligible for English learner services	0.159 (0.366)	0.138 (0.345)	0.099	0.138 (0.345)	0.126 (0.332)	0.063
Ever eligible for free or reduced-price lunch	0.866 (0.341)	0.848 (0.359)	0.089	0.845 (0.362)	0.842 (0.365)	0.015
Ever eligible for special education services	0.202 (0.401)	0.183 (0.387)	0.072	0.130 (0.337)	0.081 (0.273)	0.320
Black	0.212 (0.409)	0.199 (0.399)	0.047	0.237 (0.426)	0.215 (0.411)	0.077
Latinx	0.187 (0.390)	0.161 (0.367)	0.111	0.168 (0.374)	0.146 (0.353)	0.101
White	0.554 (0.497)	0.613 (0.487)	0.149	0.551 (0.498)	0.604 (0.489)	0.132

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table A6. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching and coarsened exact matching processes, by eligibility for free or reduced-price lunch

Group	Eligible for free or reduced-price lunch in any school year			Never eligible for free or reduced-price lunch in any school year		
	PLC at Work (N = 82 schools; 2,247 students)	Comparison (N = 304 schools; 37437 students)		*PLC at Work* (N = 17 schools; 378 students)	Comparison (N = 216 schools; 6868 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	−0.123 (0.929)	−0.110 (0.850)	0.015	0.654 (0.822)	0.625 (0.741)	0.039
Math score (standardized)	−0.083 (0.907)	−0.108 (0.822)	0.030	0.714 (0.917)	0.628 (0.779)	0.109
Grade level	5.211 (1.693)	5.319 (1.683)	0.064	5.582 (1.824)	5.152 (1.668)	0.257
Ever eligible for English learner services	0.173 (0.378)	0.157 (0.363)	0.073	0.005 (0.073)	0.000 (0.021)	1.514
Ever eligible for special education services	0.182 (0.386)	0.150 (0.357)	0.137	0.085 (0.279)	0.043 (0.202)	0.445
Black	0.257 (0.437)	0.243 (0.429)	0.045	0.026 (0.161)	0.008 (0.089)	0.736
Latinx	0.205 (0.404)	0.181 (0.385)	0.092	0.019 (0.135	0.003 (0.051)	1.195
White	0.489 (0.500)	0.541 (0.498)	0.126	0.931 (0.253)	0.981 (0.137)	0.804
Male	0.529 (0.499)	0.516 (0.500)	0.032	0.487 (0.500)	0.504 (0.500)	0.042

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table A7. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching and coarsened exact matching processes, by eligibility for special education services

Group	Eligible for special education services in any school year			Never eligible for special education services in any school year		
	PLC at Work (N = 37 schools; 440 students)	Comparison (N = 288 schools; 5922 students)		PLC at Work (N = 77 schools; 2185 students)	Comparison (N = 304 schools; 38383 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	−0.848 (0.918)	−0.905 (0.833)	0.067	0.158 (0.868)	0.145 (0.794)	0.017
Math score (standardized)	−0.648 (0.922)	−0.715 (0.797)	0.084	0.168 (0.896)	0.118 (0.812)	0.062
Grade level	5.182 (1.690)	5.153 (1.648)	0.017	5.281 (1.722)	5.315 (1.686)	0.020
Ever eligible for English learner services	0.148 (0.355)	0.087 (0.282)	0.362	0.149 (0.356)	0.139 (0.346)	0.048
Ever eligible for free or reduced-price lunch	0.927 (0.260)	0.951 (0.217)	0.251	0.842 (0.365)	0.829 (0.377)	0.057
Black	0.257 (0.437)	0.252 (0.434)	0.016	0.217 (0.413)	0.200 (0.400)	0.064
Latinx	0.177 (0.382)	0.098 (0.297)	0.418	0.178 (0.383)	0.162 (0.369)	0.068
White	0.530 (0.500)	0.639 (0.480)	0.274	0.557 (0.497)	0.604 (0.489)	0.118
Male	0.630 (0.483)	0.705 (0.456)	0.207	0.502 (0.500)	0.485 (0.500)	0.041

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Appendix B. Complete regression results

This appendix presents full regression results for main treatment effects for all students and for each group of students included in the group analysis.

Table B1. Full analytic sample results

	English language arts (ELA)	Math
PLC at Work Cohort 1 school	0.018 (0.039)	0.083* (0.034)
Baseline ELA score (standardized)	0.576*** (0.009)	0.236*** (0.010)
Baseline math score (standardized)	0.170*** (0.008)	0.464*** (0.010)
Special education	−0.239*** (0.020)	−0.134*** (0.021)
Male	−0.140*** (0.009)	0.0670*** (0.009)
Asian	0.119 (0.068)	0.085 (0.073)
Black	−0.122*** (0.014)	−0.145*** (0.013)
Latinx	0.039 (0.027)	−0.032 (0.029)
American Indian and Alaska Native	0.086 (0.105)	−0.057 (0.082)
Native Hawaiian and Pacific Islander	0.108 (0.086)	0.031 (0.130)
Two or more races	−0.060* (0.026)	−0.076* (0.034)
Free or reduced-price lunch	−0.046*** (0.012)	−0.101*** (0.013)
Baseline grade level (2016/17)	0.021** (0.007)	0.018* (0.008)
Gifted and talented	0.198*** (0.015)	0.303*** (0.018)
Suspended or expelled	−0.154*** (0.011)	−0.144*** (0.012)
Ever English learner	−0.075** (0.029)	0.006 (0.030)
Chronically absent	−0.098*** (0.011)	−0.127*** (0.013)
Propensity score	0.120 (0.295)	−0.129 (0.386)
Northwest	0.030 (0.039)	0.051 (0.042)
Northeast	0.041 (0.037)	0.040 (0.038)
Central	0.027 (0.028)	0.045 (0.033)
Southwest	0.055 (0.033)	0.070 (0.037)
School enrollment	−0.0001* (0.00003)	−0.0001 (0.00004)

	English language arts (ELA)	Math
School percentage eligible for free or reduced-price lunch	−0.001 (0.001)	−0.001 (0.001)
School average baseline math score (standardized)	−0.171* (0.075)	0.372*** (0.097)
School average baseline ELA score (standardized)	0.280*** (0.082)	−0.119 (0.095)
School percentage white	−0.0001 (0.001)	−0.001 (0.001)
School percentage current or former English learner	−0.001 (0.001)	−0.001 (0.001)
School is in a district that contains a *PLC at Work* school	0.039 (0.022)	−0.029 (0.024)
School percentage ever eligible for special education	0.001 (0.003)	−0.001 (0.004)
School percentage beginning teachers	−0.223* (0.088)	−0.340** (0.108)
Constant	0.158 (0.083)	0.177* (0.087)
School random effect (constant)	0.128*** (0.007)	0.149*** (0.011)
School random effect (residual)	0.509*** (0.006)	0.568*** (0.006)
N	46,946	46,946
N cluster	315	315
ll	−34,939.2	−40,063.1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17–2018/19.

Table B2. Results by gender

	Female		Male	
	English language arts (ELA)	Math	ELA	Math
PLC at Work Cohort 1 school	0.035 (0.037)	0.068* (0.031)	0.010 (0.047)	0.090* (0.041)
Baseline ELA score (standardized)	0.579*** (0.008)	0.242*** (0.011)	0.571*** (0.014)	0.230*** (0.014)
Baseline math score (standardized)	0.167*** (0.008)	0.456*** (0.011)	0.172*** (0.014)	.0468*** (0.015)
Special education	−0.234*** (0.021)	−0.135*** (0.022)	−0.238*** (0.028)	−0.129*** (0.029)
Asian	0.007 (0.064)	0.161 (0.086)	0.196* (0.099)	0.040 (0.086)
Black	−0.124*** (0.013)	−0.117*** (0.015)	−0.121*** (0.021)	−0.171*** (0.019)
Latinx	-0.023 (0.037)	−0.077 (0.046)	0.090* (0.036)	0.003 (0.035)
American Indian and Alaska Native	0.002 (0.134)	−0.088 (0.124)	0.221 (0.141)	−0.005 (0.098)
Native Hawaiian and Pacific Islander	0.030 (0.084)	−0.093 (0.071)	0.178 (0.136)	0.120 (0.169)
Two or more races	0.010 (0.025)	-0.056* (0.028)	−0.125** (0.041)	−0.095 (0.055)
Free or reduced-price lunch	−0.031* (0.015)	−0.100*** (0.014)	−0.064*** (0.015)	−0.105*** (0.020)
Baseline grade level (2016/17)	0.016* (0.007)	0.009 (0.009)	0.021** (0.007)	0.018* (0.008)
Gifted and talented	0.185*** (0.015)	0.276*** (0.017)	0.217*** (0.024)	0.334*** (0.029)
Suspended or expelled	−0.147*** (0.014)	−0.131*** (0.014)	−0.154*** (0.014)	−0.148*** (0.015)
Ever English learner	-0.038 (0.039)	0.038 (0.046)	−0.101** (0.039)	−0.016 (0.039)
Chronically absent	-0.093*** (0.016)	−0.127*** (0.016)	−0.101*** (0.016)	−0.124*** (0.021)
Propensity score	0.274 (0.328)	−0.225 (0.493)	−0.054 (0.351)	−0.175 (0.367)
Northwest	0.011 (0.040)	0.034 (0.042)	0.045 (0.046)	0.068 (0.050)
Northeast	0.014 (0.035)	0.033 (0.039)	0.056 (0.043)	0.050 (0.044)
Central	0.011 (0.028)	0.060 (0.032)	0.028 (0.034)	0.022 (0.040)
Southwest	0.022 (0.034)	0.059 (0.036)	0.078* (0.038)	0.075 (0.043)
School enrollment	−0.0001* (0.00003)	−0.00004 (0.00004)	−0.00004 (0.00004)	−0.00002 (0.00004)
School percentage eligible for free or reduced-price lunch	−0.0004 (0.001)	−0.001 (0.001)	−0.0004 (0.001)	−0.001 (0.001)
School average baseline math score (standardized)	−0.178* (0.075)	0.405*** (0.099)	−0.134 (0.089)	0.398*** (0.108)
School average baseline ELA score (standardized)	0.333*** (0.088)	−0.125 (0.102)	0.222* (0.094)	−0.164 (0.105)
School percentage white	−0.001	−0.001	0.0002	−0.001

	Female		Male	
	English language arts (ELA)	Math	ELA	Math
	(0.0006)	(0.001)	(0.001)	(0.001)
School percentage current or former English learner	−0.001	−0.0001	−0.001	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)
School is in a district that contains a *PLC at Work* school	−0.001	−0.041	0.064*	−0.019
	(0.021)	(0.025)	(0.027)	(0.029)
School percentage ever eligible for special education	0.001	−0.001	0.0004	−0.0002
	(0.003)	(0.004)	(0.004)	(0.004)
School percentage beginning teachers	−0.181*	−0.260*	−0.200*	−0.330**
	(0.086)	(0.109)	(0.101)	(0.120)
Constant	0.209*	0.221*	−0.024	0.206*
	(0.083)	(0.091)	(0.096)	(0.105)
School random effect (constant)	0.119***	0.138***	0.145***	0.168***
	(0.008)	(0.013)	(0.009)	(0.155)
School random effect (residual)	0.475***	0.536***	0.534***	0.591***
	(0.005)	(0.005)	(0.009)	(0.008)
N	22,790	22,790	24,156	24,156
N cluster	298	298	313	313
ll	−15,066.0	−17,766.5	−19,648.5	−22,162.5

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17–2018/19.

Table B3. Results by race/ethnicity for the three largest racial/ethnic groups

	Black		Latinx		White	
	English language arts (ELA)	Math	ELA	Math	ELA	Math
PLC at Work Cohort 1 school	0.070 (0.037)	0.019 (0.041)	−0.053 (0.042)	0.042 (0.071)	0.035 (0.034)	0.118** (0.039)
Baseline ELA score (standardized)	0.560*** (0.024)	0.265*** (0.024)	0.586*** (0.017)	0.264*** (0.023)	0.569*** (0.010)	0.218*** (0.011)
Baseline math score (standardized)	0.146*** (0.028)	0.037*** (0.029)	0.190*** (0.020)	0.488*** (0.020)	0.175*** (0.009)	0.486*** (0.010)
Special education	−0.267*** (0.059)	−0.145* (0.058)	−0.202*** (0.035)	-0.093** (0.034)	−0.231*** (0.018)	−0.147*** (0.020)
Male	−0.165*** (0.018)	0.019 (0.018)	−0.079*** (0.021)	0.113*** (0.021)	−0.145*** (0.009)	0.071*** (0.009)
Free or reduced–price lunch	−0.033 (0.063)	−0.146 (0.103)	−0.083 (0.083)	−0.079 (0.112)	−0.053*** (0.011)	−0.087*** (0.013)
Baseline grade level (2016/17)	−0.0001 (0.008)	−0.009 (0.009)	0.008 (0.012)	−0.020 (0.015)	0.029*** (0.007)	0.034*** (0.009)
Gifted and talented	0.287*** (0.049)	0.384*** (0.052)	0.189*** (0.034)	0.225*** (0.049)	0.182*** (0.013)	0.286*** (0.017)
Suspended or expelled	−0.113*** (0.014)	−0.099*** (0.017)	−0.174*** (0.036)	−0.149*** (0.025)	−0.170*** (0.013)	−0.160*** (0.014)
Ever English learner	−1.156*** (0.091)	0.147*** (0.025)	−0.059* (0.025)	0.032 (0.027)	‡	‡
Chronically absent	−0.101*** (0.019)	−0.089*** (0.025)	-0.084** (0.029)	−0.093 (0.048)	−0.092*** (0.013)	−0.138*** (0.015)
Propensity score	−0.131 (0.385)	−0.292 (0.362)	0.540 (0.584)	0.428 (1.042)	−0.371 (0.307)	−0.502 (0.356)
Northwest	0.059 (0.063)	0.082 (0.067)	0.029 (0.063)	−0.158 (0.090)	0.008 (0.042)	0.050 (0.045)
Northeast	−0.010 (0.044)	0.071 (0.039)	−0.039 (0.063)	−0.094 (0.084)	0.065 (0.040)	0.044 (0.039)
Central	0.004 (0.032)	0.017 (0.033)	0.0003 (0.055)	-0.055 (0.076)	0.033 (0.032)	0.045 (0.036)
Southwest	0.007 (0.043)	0.069 (0.040)	0.100 (0.053)	-0.025 (0.086)	0.052 (0.036)	0.063 (0.038)
School enrollment	−0.00001 (0.00004)	0.00002 (0.0001)	-0.0001 (0.0001)	0.0001 (0.0001)	-0.0001* (0.00004)	-0.0001* (0.00004)
School percentage eligible for free or reduced–price lunch	0.0002 (0.0007)	0.00006 (0.0007)	−0.001 (0.001)	−0.001 (0.001)	−0.00001 (0.0006)	−0.0008 (0.0007)
School average baseline math score (standardized)	−0.266* (0.111)	0.437*** (0.110)	−0.128 (0.131)	0.392*** (0.143)	−0.167* (0.079)	0.352** (0.111)
School average baseline ELA score (standardized)	0.473*** (0.121)	−0.179 (0.134)	0.320* (0.129)	−0.154 (0.160)	0.276** (0.086)	−0.070 (0.104)
School percentage white	0.0009 (0.0008)	0.00005 (0.0008)	−0.0008 (0.001)	−0.001 (0.001)	−0.001 (0.0007)	−0.001 (0.0008)
School percentage current or former English learner	−0.0003 (0.002)	−0.0004 (0.002)	−0.002 (0.001)	0.0008 (0.002)	−0.0005 (0.001)	−0.0003 (0.001)
School is in a district that contains a PLC at Work school	0.019 (0.029)	−0.026 (0.028)	0.011 (0.034)	−0.027 (0.043)	0.018 (0.022)	−0.047 (0.026)

School percentage ever eligible for special education	−0.003 (0.004)	−0.009[*] (0.004)	0.007 (0.005)	0.016[*] (0.006)	0.0003 (0.004)	−0.002 (0.004)
School percentage beginning teachers	−0.111 (0.116)	−0.192 (0.105)	−0.259 (0.171)	−0.195 (0.222)	-0.301[**] (0.096)	−0.436[***] (0.118)
Constant	0.061 (0.112)	0.152 (0.132)	0.302 (0.158)	0.134 (0.190)	0.204[*] (0.086)	0.172 (0.098)
School random effect (constant)	0.130[***] (0.013)	0.129[***] (0.015)	0.180[***] (0.013)	0.206[***] (0.033)	0.126[***] (0.008)	0.152[***] (0.015)
School random effect (residual)	0.504[***] (0.018)	0.531[***] (0.013)	0.480[***] (0.007)	0.549[***] (0.008)	0.512[***] (0.006)	0.579[***] (0.005)
N	9,758	9,758	7,269	7,269	28,437	28,437
N cluster	268	268	280	280	311	311
ll	-7,581.4	-8,112.4	−5,918.8	−7,042.7	−19,567.2	−22,785.8

[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17–2018/19.

Note: ‡ variables omitted because of collinearity.

Table B4. Results by federal program eligibility

	Eligible for free or reduced-price lunch in any school year		Never eligible for free or reduced-price lunch		Eligible for special education services in any school year		Never eligible for special education services	
	ELA	Math	ELA	Math	ELA	Math	ELA	Math
PLC at Work Cohort 1 school	0.018 (0.037)	0.085* (0.034)	0.100* (0.048)	0.036 (0.061)	0.026 (0.070)	0.013 (0.055)	0.020 (0.040)	0.089** (0.031)
Baseline ELA score (standardized)	0.576*** (0.010)	0.233*** (0.011)	0.561*** (0.014)	0.249*** (0.018)	0.558*** (0.032)	0.233*** (0.029)	0.581*** (0.007)	0.239*** (0.008)
Baseline math score (standardized)	0.170*** (0.010)	0.453*** (0.011)	0.172*** (0.014)	0.526*** (0.017)	0.129*** (0.032)	0.356*** (0.030)	0.180*** (0.008)	0.489*** (0.009)
Special education	−0.237*** (0.022)	−0.148*** (0.023)	−0.239*** (0.036)	−0.028 (0.040)				
Male	−0.145*** (0.009)	0.065*** (0.009)	−0.124*** (0.016)	0.087*** (0.020)	−0.146 (0.028)	0.053* (0.026)	−0.136*** (0.008)	0.068*** (0.008)
Asian	0.159* (0.075)	0.120 (0.075)	−0.215* (0.091)	−0.037 (0.118)	0.471* (0.240)	0.241*** (0.067)	0.095 (0.069)	0.086 (0.072)
Black	−0.124*** (0.015)	−0.150*** (0.014)	−0.110 (0.067)	−0.106 (0.106)	-0.154*** (0.040)	−0.156*** (0.038)	−0.112*** (0.011)	−0.141*** (0.011)
Latinx	0.037 (0.028)	−0.032 (0.029)	0.100 (0.075)	0.006 (0.096)	0.118 (0.108)	−0.129* (0.063)	0.021 (0.023)	−0.021 (0.031)
American Indian/Alaska Native	0.120 (0.113)	−0.082 (0.094)	−0.194 (0.204)	0.124 (0.197)	0.093 (0.352)	−0.039 (0.323)	0.075 (0.095)	−0.058 (0.067)
Native Hawaiian/Pacific Islander	0.106 (0.090)	0.018 (0.129)	‡	‡	-0.308* (0.144)	0.139 (0.088)	0.135 (0.112)	0.025 (0.119)
Two or more races	−0.067* (0.027)	−0.075* (0.034)	0.036 (0.085)	−0.095 (0.145)	−0.080 (0.083)	0.021 (0.095)	−0.051* (0.025)	−0.095** (0.032)
Free or reduced-price lunch					−0.057 (0.046)	−0.253*** (0.057)	−0.046*** (0.012)	−0.074*** (0.013)
Baseline grade level (2016/17)	0.023** (0.007)	0.016 (0.008)	0.007 (0.009)	0.005 (0.013)	0.034** (0.011)	-0.010 (0.012)	0.015* (0.007)	0.019* (0.009)
Gifted and talented	0.214*** (0.018)	0.328*** (0.021)	0.164*** (0.019)	0.198*** (0.028)	0.482*** (0.100)	0.689*** (0.094)	0.176*** (0.009)	0.264*** (0.014)
Suspended or expelled	−0.152*** (0.012)	−0.146*** (0.012)	−0.153*** (0.033)	−0.147*** (0.039)	−0.143*** (0.027)	−0.113*** (0.029)	-0.161*** (0.012)	−0.151*** (0.011)
Ever English learner	−0.079** (0.029)	0.007 (0.031)	0.060 (0.101)	−0.260* (0.122)	-0.236* (0.110)	0.153* (0.074)	−0.036 (0.026)	−0.013 (0.032)
Chronically absent	−0.099*** (0.012)	−0.125*** (0.014)	−0.083** (0.031)	−0.128** (0.045)	−0.089** (0.034)	−0.103*** (0.029)	−0.101*** (0.012)	−0.137*** (0.014)
Propensity score	0.140 (0.289)	−0.136 (0.394)	−0.197 (0.631)	−0.115 (0.866)	−0.531 (0.584)	−0.001 (0.514)	0.258 (0.300)	−0.215 (0.408)
Northwest	0.033 (0.039)	0.038 (0.041)	0.028 (0.058)	0.098 (0.068)	−0.016 (0.069)	0.068 (0.075)	0.040 (0.039)	0.041 (0.042)
Northeast	0.039 (0.037)	0.033 (0.037)	0.054 (0.059)	0.022 (0.063)	-0.050 (0.060)	0.0009 (0.057)	0.059 (0.037)	0.043 (0.039)
Central	0.025 (0.028)	0.032 (0.032)	0.030 (0.044)	0.118* (0.050)	−0.022 (0.049)	0.045 (0.052)	0.035 (0.029)	0.041 (0.033)
Southwest	0.054 (0.033)	0.059 (0.036)	0.042 (0.047)	0.123* (0.057)	0.041 (0.054)	0.077 (0.058)	0.056 (0.033)	0.059 (0.037)
School enrollment	-0.0001* (0.00004)	−0.0001 (0.00004)	−0.00003 (0.00004)	-0.00001 (0.0001)	-0.00001 (0.0001)	0.0001 (0.00005)	-0.0001* (0.00003)	−0.0001 (0.00004)

School percentage eligible for free or reduced-price lunch	−0.001 (0.001)	−0.001 (0.001)	0.002 (0.001)	0.001 (0.002)	0.0002 (0.001)	0.001 (0.001)	−0.0006 (0.001)	−0.001 (0.001)
School average baseline math score (standardized)	−0.177* (0.076)	0.411*** (0.096)	−0.041 (0.106)	0.298 (0.155)	−0.158 (0.134)	0.359** (0.128)	−0.164* (0.073)	−0.394*** (0.100)
School average baseline ELA score (standardized)	0.286*** (0.083)	−0.150 (0.095)	0.240* (0.110)	0.010 (0.155)	0.312* (0.148)	−0.136 (0.132)	0.260*** (0.078)	−0.140 (0.099)
School percentage white	−0.0002 (0.0007)	−0.001 (0.0007)	−0.001 (0.001)	−0.0003 (0.001)	0.0006 (0.001)	0.0004 (0.001)	-0.0004 (0.0007)	−0.001 (0.0007)
School percentage current or former English learner	−0.0008 (0.0009)	−0.0006 (0.0009)	−0.001 (0.001)	−0.001 (0.002)	0.00001 (0.001)	-0.002 (0.002)	-0.0009 (0.0009)	−0.0005 (0.001)
School is in a district that contains a *PLC at Work* school	0.038 (0.022)	−0.033 (0.025)	0.029 (0.028)	−0.032 (0.035)	0.035 (0.042)	0.00004 (0.041)	0.034 (0.021)	−0.033 (0.025)
School percentage ever eligible for special education	0.00007 (0.003)	−0.0005 (0.004)	0.009 (0.006)	−0.0008 (0.006)	−0.002 (0.005)	−0.008 (0.005)	0.0008 (0.003)	-0.0003 (0.004)
School percentage beginning teachers	-0.222* (0.089)	−0.333** (0.108)	−0.142 (0.142)	−0.124 (0.160)	−0.330* (-0.142)	−0.215 (0.150)	−0.187* (0.090)	−0.331** (0.113)
Constant	0.125 (0.084)	0.101 (0.086)	0.008 (0.142)	−0.029 (0.162)	−0.198 (0.152)	0.072 (0.154)	0.194* (0.083)	0.187* (0.091)
School random effect (constant)	0.128*** (0.007)	0.148*** (0.011)	0.121*** (0.012)	0.136*** (0.016)	0.184*** (0.018)	0.186*** (0.023)	0.128*** (0.007)	0.151*** (0.010)
School random effect (residual)	0.517*** (0.007)	0.570*** (0.006)	0.452*** (0.007)	0.546*** (0.009)	0.595*** (0.021)	0.610*** (0.015)	0.485*** (0.003)	0.552*** (0.005)
N	39,699	39,699	7,247	7,247	6,364	6,364	40,582	40,582
N cluster	312	312	221	221	293	293	312	312
ll	−30,455.8	−34,347.3	−4,370.6	−5,660.7	−7,204.1	−7,397.5	−27,186.0	−32,247.5

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17–2018/19.

Note: ‡ variables omitted because of collinearity.

Table B5. Results by eligibility for English learner services

	Current English learner in baseline year		Former English learner in baseline year		Never English learner	
	English language arts (ELA)	Math	ELA	Math	ELA	Math
PLC at Work Cohort 1 school	−0.055 (0.054)	0.017 (0.066)	−0.034 (0.049)	0.152* (0.076)	0.038 (0.036)	0.090** (0.029)
Baseline ELA score (standardized)	0.562*** (0.029)	0.272*** (0.042)	0.500*** (0.033)	0.165*** (0.032)	0.570*** (0.010)	0.231*** (0.011)
Baseline math score (standardized)	0.199*** (0.020)	0.444*** (0.034)	0.100*** (0.030)	0.465*** (0.034)	0.170*** (0.009)	0.464*** (0.010)
Special education	−0.239*** (0.043)	−0.060 (0.044)	−0.060 (0.104)	−0.041 (0.089)	−0.237*** (0.022)	-0.143*** (0.023)
Male	−0.038 (0.028)	0.096*** (0.029)	−0.110*** (0.031)	0.116** (0.037)	−0.152*** (0.008)	0.060*** (0.009)
Asian	−0.282 (0.181)	-0.312 (0.358)	0.012 (0.192)	0.331 (0.178)	0.019 (0.062)	0.086 (0.061)
Black	−1.793*** (0.197)	−0.429 (0.359)	‡	‡	−0.126*** (0.014)	−0.148*** (0.014)
Latinx	−0.455** (0.157)	-0.558 (0.347)	−0.062 (0.181)	0.180** (0.068)	0.039 (0.026)	−0.024 (0.030)
American Indian/Alaska Native	0.403** (0.152)	−1.323*** (0.348)	‡	‡	0.072 (0.105)	−0.051 (0.083)
Native Hawaiian/Pacific Islander	−0.313 (0.160)	−0.354 (0.408)	0.0005 (0.205)	0.004 (0.110)	-0.285* (0.117)	−0.188 (0.227)
Two or more races					−0.064* (0.026)	−0.079* (0.034)
Free or reduced–price lunch	0.125** (0.046)	0.249*** (0.069)	‡	‡	−0.051*** (0.011)	−0.100*** (0.013)
Baseline grade level (2016/17)	0.013 (0.015)	-0.051*** (0.016)	0.023 (0.016)	0.008 (0.019)	0.022** (0.007)	0.022* (0.009)
Gifted and talented	0.298*** (0.072)	0.390*** (0.083)	0.174*** (0.034)	0.256*** (0.058)	0.205*** (0.016)	0.305*** (0.019)
Suspended or expelled	−0.239*** (0.032)	−0.182*** (0.040)	−0.237*** (0.038)	−0.153 (0.095)	−0.145*** (0.011)	−0.140*** (0.012)
Chronically absent	−0.158*** (0.045)	−0.127* (0.054)	0.091 (0.081)	−0.064 (0.067)	-0.095*** (0.013)	−0.124*** (0.015)
Propensity score	1.422* (0.664)	−0.155 (0.702)	−1.898 (1.010)	−0.342 (0.989)	0.014 (0.293)	−0.152 (0.384)
Northwest	0.191* (0.087)	−0.014 (0.086)	0.033 (0.120)	−0.180 (0.173)	0.011 (0.039)	0.065 (0.043)
Northeast	0.146 (0.091)	-0.034 (0.086)	0.060 (0.123)	−0.056 (0.179)	0.039 (0.038)	0.047 (0.038)
Central	0.070 (0.075)	−0.033 (0.079)	−0.016 (0.095)	−0.084 (0.157)	0.030 (0.280)	0.056 (0.033)
Southwest	0.210** (0.082)	0.129 (0.089)	0.081 (0.117)	−0.153 (0.169)	0.041 (0.033)	0.070 (0.037)
School enrollment	0.00001 (0.0001)	0.0001 (0.0001)	−0.00003 (0.0001)	0.00007 (0.0001)	−0.00009** (0.00003)	−0.00006 (0.00004)
School percentage eligible for free or reduced–price lunch	0.0007 (0.001)	−0.0003 (0.001)	0.001 (0.002)	−0.001 (0.002)	−0.0005 (0.0006)	−0.0007 (0.0007)
School average baseline math score (standardized)	−0.092 (0.157)	0.303* (0.154)	0.120 (0.199)	0.446* (0.210)	−0.201** (0.076)	0.359*** (0.101)

School average baseline ELA score (standardized)	0.274 (0.140)	−0.201 (0.149)	0.124 (0.185)	−0.242 (0.217)	0.320*** (0.085)	−0.090 (0.097)
School percentage white	0.001 (0.001)	0.0007 (0.001)	−0.003 (0.002)	0.0004 (0.002)	-0.0004 (0.0007)	−0.001 (0.0007)
School percentage current or former English learner	−0.001 (0.002)	0.0007 (0.002)	−0.003 (0.002)	0.001 (0.003)	0.00007 (0.001)	−0.0006 (0.0009)
School is in a district that contains a *PLC at Work* school	0.027 (0.039)	−0.008 (0.041)	0.104* (0.051)	0.008 (0.053)	0.028 (0.021)	−0.039 (0.024)
School percentage ever eligible for special education	0.0008 (0.007)	0.008 (0.007)	−0.012 (0.009)	−0.002 (0.008)	0.001 (0.003)	−0.001 (0.004)
School percentage beginning teachers	0.110 (0.207)	0.169 (0.224)	−0.380 (0.275)	−0.226 (0.357)	−0.268** (0.090)	-0.360*** (0.109)
Constant	−0.043 (0.245)	0.322 (0.360)	0.461 (0.300)	−0.003 (0.266)	0.186* (0.084)	0.185* (0.090)
School random effect (constant)	0.164 (0.016)	0.153*** (0.016)	0.206*** (0.027)	0.194*** (0.023)	0.126*** (0.007)	0.149*** (0.012)
School random effect (residual)	0.474 (0.013)	0.540*** (0.010)	0.432*** (0.011)	0.534*** (0.017)	0.512*** (0.007)	0.570*** (0.006)
N	3,735	3,735	2,520	2,520	40,691	40,691
N cluster	240	240	206	206	314	314
ll	−3,086.8	−3,642.2	−1,593.3	−2,115.3	-29,915.9	-34,148.3

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.
Note: ‡ variables omitted because of collinearity.

Appendix C. Supplementary results

This appendix presents results using propensity score matching to determine baseline equivalency between *PLC at Work* students and comparison students. That is, the second-stage matching procedure—coarsened exact matching—is not performed. The analysis complements the main study's findings with results that are similar in direction and magnitude. Baseline equivalency tables (tables C1–C6) are followed by full regression results (tables C7–C10).

Table C1. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching process

Variables	PLC at Work (N = 122 schools; 3,301 students)		Comparison (N = 587 schools; 109,696 students)		
	Mean	S.D.	Mean	S.D.	Hedge's g or Cox's index
English language arts score (standardized)	0.011	0.638	−0.004	0.658	0.024
Math score (standardized)	0.040	0.650	0.038	0.661	0.003
Grade level	5.201	1.655	5.389	1.710	0.110
Ever eligible for English learner services	0.131	0.338	0.134	0.340	0.014
Ever eligible for free or reduced-price lunch	0.830	0.376	0.806	0.395	0.098
Ever eligible for special education services	0.179	0.383	0.188	0.391	0.037
Black	0.208	0.406	0.173	0.378	0.138
Latinx	0.164	0.370	0.156	0.363	0.034
White	0.582	0.493	0.606	0.489	0.062
Male	0.520	0.500	0.518	0.500	0.006

$*$ $p < 0.05$, $**$ $p < 0.01$, $***$ $p < 0.001$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C2. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching process, by race/ethnicity

Group	Black			Latinx			White		
	PLC at Work (N =52 schools; 685 students)	Comparison (N = 459 schools; 18,924 students)		*PLC at Work* (N =43 schools; 541 students)	Comparison (N = 543 schools; 17,148 students)		*PLC at Work* (N = 79 schools; 1,921 students)	Comparison (N = 565 schools; 66,528 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	−0.201 (0.600)	−0.261 (0.622)	0.096	−0.039 (0.590)	−0.067 (0.613)	0.046	0.099 (0.641)	0.083 (0.656)	0.025
Math score (standardized)	−0.190 (0.594)	−0.254 (0.595)	0.108	−0.018 (0.590)	−0.009 (0.591)	0.017	0.136 (0.658)	0.130 (0.665)	0.010
Grade level	5.382 (1.482)	5.440 (1.793)	0.032	5.887 (1.943)	5.325 (1.692)	0.331	4.940 (1.561)	5.392 (1.694)	0.267
Ever eligible for English learner services	0.003 (0.054)	0.003 (0.050)	0.086	0.741 (0.438)	0.737 (0.440)	0.014	0.001 (0.032)	0.003 (0.051)	0.566
Ever eligible for free or reduced-price lunch	0.968 (0.176)	0.966 (0.181)	0.031	0.967 (0.180)	0.961 (0.194)	0.103	0.737 (0.440)	0.715 (0.451)	0.066
Ever eligible for special education services	0.193 (0.395)	0.210 (0.407)	0.065	0.179 (0.384)	0.158 (0.365)	0.092	0.174 (0.380)	0.191 (0.393)	0.069
Male	0.498 (0.500)	0.507 (0.500)	0.022	0.555 (0.497)	0.516 (0.500)	0.094	0.516 (0.500)	0.522 (0.499)	0.015

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C3. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching process, by English learner status

Group	Current English learner			Former English learner			Never English learner		
	PLC at Work (N = 29 schools; 286 students)	Comparison (N = 425 schools; 8,899 students)		PLC at Work (N = 18 schools; 147 students)	Comparison (N = 356 schools; 5,772 students)		PLC at Work (N = 116 schools; 2,868 students)	Comparison (N = 586 schools; 95,025 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	−0.206 (0.640)	−0.291 (0.626)	0.135	0.218 (0.461)	0.209 (0.465)	0.020	0.022 (0.640)	0.010 (0.663)	0.019
Math score (standardized)	−0.154 (0.647)	−0.181 (0.581)	0.047	0.204 (0.509)	0.235 (0.548)	0.057	0.051 (0.653)	0.046 (0.669)	0.006
Grade level	6.497 (1.871)	5.542 (1.726)	0.551	5.551 (1.966)	5.077 (1.609)	0.293	5.054 (1.553)	5.393 (1.712)	0.199
Ever eligible for free or reduced-price lunch	0.979 (0.144)	0.981 (0.138)	0.047	0.986 (0.116)	0.965 (0.185)	0.592	0.807 (0.395)	0.780 (0.414)	0.101
Ever eligible for special education services	0.234 (0.424)	0.200 (0.400)	0.121	0.034 (0.182)	0.054 (0.226)	0.291	0.181 (0.385)	0.195 (0.396)	0.057
Black	0.007 (0.083)	0.004 (0.062)	0.368	0.000 (0.000)	0.002 (0.049)	0.000	0.238 (0.426)	0.199 (0.399)	0.141
Latinx	0.937 (0.243)	0.853 (0.355)	0.573	0.905 (0.295)	0.874 (0.332)	0.190	0.049 (0.216)	0.048 (0.213)	0.017
White	0.000 (0.000)	0.012 (0.109)	0.000	0.014 (0.116	0.012 (0.109)	0.079	0.669 (0.471)	0.698 (0.459)	0.082
Male	0.566 (0.496)	0.562 (0.496)	0.011	0.517 (0.501)	0.460 (0.498)	0.138	0.516 (0.500)	0.517 (0.500)	0.003

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C4. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching process, by gender

Group	Male			Female		
	PLC at Work (N = 84 schools; 1,717 students)	Comparison (N = 582 schools; 56,793 students)		*PLC at Work* (N = 79 schools; 1,584 students)	Comparison (N = 571 schools; 52,903 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	−0.082 (0.659)	−0.105 (0.670)	0.035	0.112 (0.599)	0.104 (0.626)	0.012
Math score (standardized)	0.028 (0.680)	0.014 (0.692)	0.020	0.052 (0.617)	0.064 (0.624)	0.018
Grade level	5.212 (1.681)	5.398 (1.713)	0.109	5.190 (1.627)	5.379 (1.706)	0.111
Ever eligible for English learner services	0.139 (0.346)	0.135 (0.342)	0.019	0.123 (0.329)	0.133 (0.339)	0.051
Ever eligible for free or reduced-price lunch	0.839 (0.367)	0.805 (0.396)	0.144	0.820 (0.384)	0.807 (0.394)	0.050
Ever eligible for special education services	0.217 (0.412)	0.236 (0.425)	0.066	0.137 (0.344)	0.136 (0.343)	0.005
Black	0.199 (0.399)	0.169 (0.375)	0.120	0.217 (0.412)	0.176 (0.381)	0.157
Latinx	0.175 (0.380)	0.156 (0.363)	0.083	0.152 (0.359)	0.157 (0.364)	0.022
White	0.578 (0.494)	0.612 (0.487)	0.086	0.586 (0.493)	0.600 (0.490)	0.035

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C5. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching process, by eligibility for free or reduced-price lunch

Group	Eligible for free or reduced-price lunch in any school year			Never eligible for free or reduced-price lunch in any school year		
	PLC at Work (N = 117 schools; 2,740 students)	Comparison (N = 585 schools; 88416 students)		*PLC at Work* (N = 24 schools; 561 students)	Comparison (N = 421 schools; 21,280 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	−0.058 (0.620)	−0.081 (0.638)	0.036	0.349 (0.617)	0.315 (0.643)	0.054
Math score (standardized)	−0.033 (0.611)	−0.041 (0.622)	0.013	0.394 (0.717)	0.367 (0.713)	0.038
Grade level	5.157 (1.639)	5.380 (1.715)	0.130	5.419 (1.716)	5.425 (1.686)	0.004
Ever eligible for English learner services	0.155 (0.362)	0.162 (0.368)	0.030	0.014 (0.119)	0.018 (0.132)	0.134
Ever eligible for special education services	0.193 (0.395)	0.205 (0.404)	0.045	0.107 (0.309)	0.116 (0.320)	0.053
Black	0.242 (0.428)	0.207 (0.405)	0.123	0.039 (0.194)	0.030 (0.171)	0.168
Latinx	0.191 (0.393)	0.186 (0.389)	0.018	0.032 (0.176)	0.032 (0.175)	0.010
White	0.517 (0.500)	0.538 (0.499)	0.052	0.900 (0.300)	0.890 (0.313)	0.068
Male	0.526 (0.499)	0.517 (0.500)	0.022	0.492 (0.500)	0.521 (0.500)	0.071

* *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C6. Baseline means and standard deviations of treatment and comparison group student characteristics after the propensity score matching processes, by eligibility for special education services

Group	Eligible for special education services in any school year			Never eligible for special education services in any school year		
	PLC at Work (N = 50 schools; 590 students)	Comparison (N = 564 schools; 20615 students)		*PLC at Work* (N = 106 schools; 2711 students)	Comparison (N = 585 schools; 89081 students)	
Variable	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index	Mean (S.D.)	Mean (S.D.)	Hedge's g or Cox's index
English language arts score (standardized)	-0.490 (0.720)	-0.490 (0.750)	0.000	0.120 (0.562)	0.108 (0.579)	0.021
Math score (standardized)	-0.317 (0.727)	-0.321 (0.710)	0.006	0.117 (0.605)	0.121 (0.620)	0.006
Grade level	5.100 (1.571)	5.351 (1.678)	0.150	5.224 (1.672)	5.397 (1.717)	0.101
Ever eligible for English learner services	0.122 (0.328)	0.102 (0.302)	0.125	0.133 (0.340)	0.141 (0.348)	0.041
Ever eligible for free or reduced-price lunch	0.898 (0.303)	0.881 (0.324)	0.109	0.815 (0.388)	0.789 (0.408)	0.101
Black	0.224 (0.417)	0.193 (0.395)	0.114	0.204 (0.403)	0.168 (0.374)	0.145
Latinx	0.164 (0.371)	0.131 (0.338)	0.159	0.164 (0.370)	0.162 (0.369)	0.008
White	0.568 (0.496)	0.618 (0.486)	0.125	0.585 (0.493)	0.604 (0.489)	0.047
Male	0.632 (0.483)	0.651 (0.477)	0.049	0.496 (0.500)	0.487 (0.500)	0.021

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C7. Full analytic sample results

	English language arts (ELA)	Math
PLC at Work Cohort 1 school	0.044[*]	0.061[***]
	(0.017)	(0.019)
Baseline ELA score (standardized)	0.603[***]	0.347[***]
	(0.004)	(0.004)
Baseline math score (standardized)	0.278[***]	0.477[***]
	(0.004)	(0.004)
Special education	−0.354[***]	−0.243[***]
	(0.005)	(0.005)
Male	−0.192[***]	0.061[***]
	(0.004)	(0.004)
Asian	0.073[***]	0.163[***]
	(0.018)	(0.019)
Black	−0.198[***]	−0.235[***]
	(0.006)	(0.007)
Latinx	−0.032[***]	−0.066[***]
	(0.009)	(0.009)
American Indian and Alaska Native	−0.027	−0.019
	(0.030)	(0.032)
Native Hawaiian and Pacific Islander	−0.141[***]	−0.220[***]
	(0.022)	(0.023)
Two or more races	−0.043[***]	−0.068[***]
	(0.009)	(0.010)
Free or reduced-price lunch	−0.125[***]	−0.154[***]
	(0.005)	(0.005)
Baseline grade level (2016/17)	0.008[***]	0.008[***]
	(0.002)	(0.002)
Gifted and talented	0.393[***]	0.479[***]
	(0.006)	(0.006)
Suspended or expelled	−0.230[***]	−0.209[***]
	(0.005)	(0.005)
Ever English learner	−0.076[***]	−0.051[***]
	(0.010)	(0.010)
Chronically absent	−0.130[***]	−0.169[***]
	(0.006)	(0.006)
Propensity score	1.236	−0.676
	(0.849)	(0.988)
Northwest	0.036	0.027

	English language arts (ELA)	Math
	(0.024)	(0.028)
Northeast	0.041	0.036
	(0.023)	(0.027)
Central	0.012	0.029
	(0.021)	(0.025)
Southwest	0.049[*]	0.068[*]
	(0.024)	(0.028)
School enrollment	−0.00002	−0.0000005
	(0.00002)	(0.00002)
School percentage eligible for free or reduced-price lunch	0.0002	0.00001
	(0.0004)	(0.0004)
School average baseline math score (standardized)	−0.075	0.504[***]
	(0.047)	(0.055)
School average baseline ELA score (standardized)	0.364[***]	−0.084
	(0.047)	(0.055)
School percentage white	−0.0002	−0.002[***]
	(0.0003)	(0.0004)
School percentage current or former English learner	−0.0005	−0.0003
	(0.0005)	(0.0006)
School is in a district that contains a *PLC at Work* school	0.019	−0.027
	(0.015)	(0.017)
School percentage ever eligible for special education	0.002	0.002
	(0.002)	(0.002)
School percentage beginning teachers	−0.031	−0.239[***]
	(0.045)	(0.052)
Constant	0.213[***]	0.217[***]
	(0.049)	(0.057)
School random effect (constant)	−2.191[***]	−2.019[***]
	(0.039)	(0.038)
School random effect (residual)	−0.520[***]	−0.456[***]
	(0.002)	(0.002)
N	112997	112997
N cluster	31	31
ll	−102147.4	−109374.4

[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C8. Results by gender

	Female		Male	
	English language arts (ELA)	Math	ELA	Math
PLC at Work Cohort 1 school	0.049[*] (0.022)	0.035 (0.024)	0.030 (0.023)	0.080[**] (0.025)
Baseline ELA score (standardized)	0.597[***] (0.005)	0.356[***] (0.006)	0.608[***] (0.005)	0.341[***] (0.005)
Baseline math score (standardized)	0.268[***] (0.005)	0.470[***] (0.005)	0.283[***] (0.005)	0.481[***] (0.005)
Special education	−0.432[***] (0.008)	−0.284[***] (0.008)	−0.303[***] (0.007)	−0.217[***] (0.007)
Asian	0.047 (0.025)	0.166[***] (0.027)	0.103[***] (0.026)	0.161[***] (0.027)
Black	−0.188[***] (0.009)	−0.197[***] (0.010)	−0.208[***] (0.009)	−0.272[***] (0.010)
Latinx	−0.041[***] (0.012)	−0.062[***] (0.013)	−0.023 (0.013)	−0.069[***] (0.013)
American Indian and Alaska Native	−0.010 (0.040)	−0.079 (0.043)	−0.042 (0.044)	0.045 (0.046)
Native Hawaiian and Pacific Islander	−0.175[***] (0.031)	−0.179[***] (0.033)	−0.117[***] (0.031)	−0.256[***] (0.033)
Two or more races	−0.026[*] (0.013)	−0.064[***] (0.013)	−0.058[***] (0.014)	−0.069[***] (0.015)
Free or reduced-price lunch	−0.120[***] (0.007)	−0.159[***] (0.008)	−0.130[***] (0.007)	−0.150[***] (0.008)
Baseline grade level (2016/17)	0.011[***] (0.003)	0.008[*] (0.003)	0.002 (0.003)	0.005 (0.003)
Gifted and talented	0.355[***] (0.008)	0.442[***] (0.008)	0.436[***] (0.008)	0.517[***] (0.009)
Suspended or expelled	−0.229[***] (0.008)	−0.204[***] (0.009)	−0.227[***] (0.007)	−0.210[***] (0.007)
Ever English learner	−0.073[***] (0.013)	−0.052[***] (0.014)	−0.080[***] (0.014)	−0.051[***] (0.015)
Chronically absent	−0.130[***] (0.008)	−0.164[***] (0.009)	−0.131[***] (0.008)	−0.173[***] (0.009)
Propensity score	1.185 (0.878)	−0.899 (1.040)	1.234 (0.944)	−0.886 (1.043)
Northwest	0.043	0.029	0.031	0.023

	Female		Male	
	English language arts (ELA)	Math	ELA	Math
	(0.025)	(0.029)	(0.026)	(0.029)
Northeast	0.052*	0.035	0.034	0.034
	(0.024)	(0.028)	(0.026)	(0.029)
Central	0.011	0.042	0.010	0.016
	(0.022)	(0.026)	(0.024)	(0.026)
Southwest	0.038	0.069*	0.060*	0.065*
	(0.025)	(0.029)	(0.027)	(0.029)
School enrollment	−0.00003	−0.000003	0.000002	0.00001
	(0.00002)	(0.00003)	(0.00002)	(0.00003)
School percentage eligible for free or reduced-price lunch	−0.0001	0.00003	0.0007	0.0001
	(0.0004)	(0.0005)	(0.0004)	(0.0005)
School average baseline math score (standardized)	−0.092	0.517***	−0.0440	0.508***
	(0.049)	(0.058)	(0.053)	(0.058)
School average baseline ELA score (standardized)	0.372***	-0.116*	0.350***	−0.067
	(0.049)	(0.058)	(0.053)	(0.058)
School percentage white	0.0001	-0.0008	−0.0006	−0.002***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
School percentage current or former English learner	−0.0003	-0.00005	−0.0007	−0.0006
	(0.0005)	(0.0006)	(0.0006)	(0.0006)
School is in a district that contains a *PLC at Work* school	0.003	−0.036*	0.034*	−0.015
	(0.015)	(0.018)	(0.017)	(0.018)
School percentage ever eligible for special education	0.002	0.002	0.002	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
School percentage beginning teachers	−0.009	−0.232***	−0.022	−0.210***
	(0.048)	(0.056)	(0.051)	(0.056)
Constant	0.207***	0.182**	0.024	0.301***
	(0.052)	(0.061)	(0.056)	(0.061)
School random effect (constant)	−2.255***	−2.045***	−2.168***	−2.052***
	(0.048)	(0.044)	(0.045)	(0.044)
School random effect (residual)	−0.565***	−0.495***	−0.484***	−0.423***
	(0.003)	(0.003)	(0.003)	(0.003)
N	54487	54487	58510	58510
N cluster	30	30	30	30
ll	−46902.7	-50728.6	−55053.9	−58639.3

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C9. Results by race/ethnicity for the three largest racial/ethnic groups

	Black		Latinx		White	
	English language arts (ELA)	Math	ELA	Math	ELA	Math
PLC at Work Cohort 1 school	0.102**	0.090**	−0.031	0.045	0.031	0.045
	(0.033)	(0.033)	(0.034)	(0.036)	(0.022)	(0.025)
Baseline ELA score (standardized)	0.563***	0.300***	0.621***	0.364***	0.610***	0.353***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.005)	(0.005)
Baseline math score (standardized)	0.249***	0.328***	0.294***	0.480***	0.284***	0.512***
	(0.008)	(0.008)	(0.009)	(0.010)	(0.005)	(0.005)
Special education	−0.312***	−0.200***	−0.354***	−0.225***	−0.367***	−0.267***
	(0.011)	(0.012)	(0.013)	(0.014)	(0.006)	(0.007)
Male	−0.204***	-0.002	-0.173***	0.080***	-0.193***	0.068***
	(0.009)	(0.009)	(0.009)	(0.010)	(0.005)	(0.005)
Free or reduced–price lunch	−0.202***	−0.237***	−0.139***	−0.148***	−0.118***	−0.135***
	(0.024)	(0.024)	(0.024)	(0.026)	(0.006)	(0.006)
Baseline grade level (2016/17)	−0.008	-0.004	0.010*	0.001	0.011***	0.012***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)
Gifted and talented	0.563***	0.564***	0.419***	0.513***	0.350***	0.437***
	(0.014)	(0.014)	(0.016)	(0.018)	(0.007)	(0.008)
Suspended or expelled	-0.195***	-0.161***	-0.230***	-0.250***	-0.234***	-0.221***
	-0.009	-0.010	-0.014	-0.015	-0.007	-0.008
Ever English learner	0.173*	0.033	−0.087***	−0.052***	−0.006	0.027
	(0.083)	(0.084)	(0.012)	(0.013)	(0.045)	(0.049)
Chronically absent	−0.122***	−0.144***	−0.137***	−0.168***	−0.127***	−0.180***
	(0.013)	(0.013)	(0.016)	(0.018)	(0.008	(0.008)
Propensity score	−0.066	−1.343	1.797	−0.938	1.523	−0.246
	(1.245)	(1.256)	(1.224)	(1.303)	(1.000)	(1.182)
Northwest	0.078	0.057	0.033	−0.054	0.035	0.031
	(0.042)	(0.043)	(0.042)	(0.045)	(0.027)	(0.032)
Northeast	0.046	0.058*	0.014	-0.027	0.044	0.040
	(0.029)	(0.029)	(0.044)	(0.047)	(0.027)	(0.032)
Central	0.004	0.009	−0.015	-0.032	0.022	0.051
	(0.025)	(0.026)	(0.038)	(0.041)	(0.025)	(0.030)
Southwest	0.048	0.063*	0.079	0.022	0.042	0.075*
	(0.031)	(0.031)	(0.042)	(0.045)	(0.027)	(0.032)
School enrollment	0.00003	0.00001	−0.00002	0.0000005	−0.00002	0.00002
	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00002)	(0.00003)

School percentage eligible for free or reduced–price lunch	0.0009	0.0002	−0.00005	−0.000008	0.0003	−0.00009
	(−0.0006)	(−0.0006)	(0.0006)	(0.0007)	(0.0004)	(0.0005)
School average baseline math score (standardized)	−0.171[*]	0.489[***]	0.114	0.459[***]	−0.055	0.503[***]
	(0.079)	(0.079)	(0.075)	(0.080)	(0.051)	(0.061)
School average baseline ELA score (standardized)	0.487[***]	−0.146	0.381[***]	−0.107	0.336[***]	−0.070
	(0.083)	(0.083)	(0.075)	(0.080)	(0.052)	(0.062)
School percentage white	0.001	−0.0001	0.001	−0.0003	−0.001	−0.001[*]
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0004)	(0.0005)
School percentage current or former English learner	0.0003	0.0006	0.00002	0.0006	−0.0008	0.0002
	(0.0009)	(0.0009)	(0.0007)	(0.0008)	(0.0006)	(0.0007)
School is in a district that contains a PLC at Work school	−0.024	−0.063[**]	0.024	−0.025	0.028	−0.015
	(0.020)	(0.020)	(0.022)	(0.023)	(0.017)	(0.020)
School percentage ever eligible for special education	0.001	−0.002	0.007[*]	0.006	0.002	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)
School percentage beginning teachers	0.057	−0.255[**]	−0.046	−0.358[***]	−0.067	−0.224[***]
	(0.077)	(0.077)	(0.083)	(0.089)	(0.049)	(0.057)
Constant	0.049	0.048	0.103	0.120	0.231[***]	0.116
	(0.076)	(0.076)	(0.088)	(0.094)	(0.057)	(0.068)
School random effect (constant)	−2.267[***]	-2.260[***]	−2.132[***]	−2.079[***]	−2.213[***]	−2.006[***]
	(0.077)	(0.081)	(0.074)	(0.071)	(0.046)	(0.043)
School random effect (residual)	−0.550[***]	−0.540[***]	−0.537[***]	−0.462[***]	−0.511[***]	−0.442[***]
	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)
N	19609	19609	17689	17689	68449	68449
N cluster	25	25	25	25	25	25
ll	−17172.8	−17378.8	−15760.1	−17093.9	−62546.9	−67304.5

[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C10. Results by federal program eligibility

	Eligible for free or reduced-price lunch in any school year		Never eligible for free or reduced-price lunch		Eligible for special education services in any school year		Never eligible for special education services	
	ELA	Math	ELA	Math	ELA	Math	ELA	Math
PLC at Work Cohort 1 school	0.034	0.077***	0.097**	−0.003	−0.017	−0.002	0.052**	0.066***
	(0.019)	(0.020)	(0.036)	(0.041)	(0.036)	(0.037)	(0.018)	(0.020)
Baseline ELA score (standardized)	0.616***	0.350***	0.540***	0.335***	0.602***	0.331***	0.602***	0.360***
	(0.004)	(0.004)	(0.008)	(0.009)	(0.008)	(0.008)	(0.004)	(0.005)
Baseline math score (standardized)	0.284***	0.459***	0.268***	0.539***	0.233***	0.359***	0.290***	0.514***
	(0.004)	(0.004)	(0.007)	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)
Special education	−0.348***	−0.243***	−0.341***	−0.250***				
	(0.005)	(0.006)	(0.012)	(0.014)				
Male	−0.191***	0.060***	−0.198***	0.063***	−0.119***	0.096***	−0.208***	0.054***
	(0.004)	(0.004)	(0.008)	(0.009)	(0.010)	(0.010)	(0.004)	(0.004)
Asian	0.091***	0.162***	0.007	0.156***	0.201**	0.141*	0.054**	0.151***
	(0.021)	(0.022)	(0.034)	(0.039)	(0.064)	(0.065)	(0.018)	(0.020)
Black	−0.195***	−0.237***	−0.145***	−0.216***	−0.179***	−0.219***	−0.203***	−0.238***
	(0.007)	(0.007)	(0.023)	(0.026)	(0.016)	(0.016)	(0.007)	(0.008)
Latinx	−0.026**	−0.063***	−0.027	−0.068*	−0.020	−0.055*	−0.036***	−0.071***
	(0.009)	(0.010)	(0.024)	(0.027)	(0.023)	(0.023)	(0.009)	(0.010)
American Indian/Alaska Native	−0.030	−0.030	−0.017	0.019	0.025	0.080	−0.038	−0.039
	(0.034)	(0.036)	(0.061)	(0.069)	(0.073)	(0.074)	(0.032)	(0.035)
Native Hawaiian/Pacific Islander	−0.129***	−0.221***	−0.095	−0.147	−0.032	−0.183**	−0.158***	−0.227***
	(0.022)	(0.024)	(0.179)	(0.203)	(0.070)	(0.071)	(0.023)	(0.024)
Two or more races	−0.044*** −	−0.067***	−0.027	−0.081**	−0.067**	−0.084***	−0.037***	−0.063***
	(0.010)	(0.011)	(0.023)	(0.026)	(0.023)	(0.024)	(0.010)	(0.011)
Free or reduced-price lunch					−0.183***	−0.202***	−0.111***	−0.135***
					(0.015)	(0.016)	(0.005)	(0.006)
Baseline grade level (2016/17)	0.010***	0.008**	−0.006	−0.002	0.016***	−0.001	0.003	0.008**
	(0.002)	(0.003)	(0.004)	(0.005)	(0.004)	(0.004)	(0.002)	(0.003)
Gifted and talented	0.444***	0.520***	0.305***	0.372***	0.760***	0.862***	0.365***	0.432***
	(0.007)	(0.007)	(0.010)	(0.012)	(0.024)	(0.024)	(0.006)	(0.006)
Suspended or expelled	−0.225***	−0.207***	−0.224***	−0.247***	−0.174***	−0.161***	−0.245***	−0.221***
	(0.005)	(0.006)	(0.017)	(0.019)	(0.012)	(0.012)	(0.006)	(0.006)
Ever English learner	−0.080***	−0.049***	0.025	−0.042	−0.094***	-0.043	−0.072***	−0.048***
	(0.010)	(0.011)	(0.034)	(0.039)	(0.027)	(0.027)	(0.010)	(0.011)
Chronically absent	−0.129***	−0.169***	−0.104***	−0.155***	−0.120***	−0.133***	−0.132***	−0.178***
	(0.006)	(0.007)	(0.018)	(0.021)	(0.014)	(0.014)	(0.006)	(0.007)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Propensity score	1.029	−0.900	2.886*	−0.577	1.639	−0.866	1.261	−0.650
	(0.858)	(0.990)	(1.345)	(1.566)	(1.096)	(1.086)	(0.883)	(1.074)
Northwest	0.036	0.022	0.078*	0.055	0.069*	0.047	0.028	0.019
	(0.024)	(0.028)	(0.037)	(0.043)	(0.031)	(0.031)	(0.025)	(0.030)
Northeast	0.039	0.030	0.0950*	0.053	0.059	0.042	0.039	0.032
	(0.024)	(0.027)	(0.039)	(0.046)	(0.031)	(0.030)	(0.024)	(0.029)
Central	0.015	0.023	0.015	0.072	0.038	0.035	0.003	0.023
	(0.022)	(0.025)	(0.034)	(0.039)	(0.029)	(0.029)	(0.022)	(0.027)
Southwest	0.055*	0.069*	0.034	0.068	0.080*	0.095**	0.042	0.057
	(0.024)	(0.028)	(0.037)	(0.043)	(0.032)	(0.032)	(0.025)	(0.030)
School enrollment	-0.00003	-0.00001	0.00004	0.00006*	0.000006	0.00004	-0.00001	0.000003
	(0.00002)	(0.00003)	(0.00003)	(0.00003)	(0.00003)	(0.00002)	(0.00002)	(0.00003)
School percentage eligible for free or reduced-price lunch	0.0001	-0.0001	0.001	0.001	0.0006	0.0008	0.0002	-0.00009
	(0.0004)	(0.0004)	(0.0009)	(0.001)	(0.0005)	(0.0005)	(0.0004)	(0.0005)
School average baseline math score (standardized)	−0.081	0.504***	0.001	0.494***	0.020	0.423***	−0.089	0.525***
	(0.048)	(0.055)	(0.070)	(0.081)	(0.061)	(0.060)	(0.049)	(0.060)
School average baseline ELA score (standardized)	0.374***	−0.086	0.269***	−0.041	0.206***	−0.107	0.395***	−0.088
	(0.048)	(0.055)	(0.073)	(0.085)	(0.062)	(0.062)	(0.049)	(0.060)
School percentage white	−0.0003	−0.001***	−0.0006	−0.0009	−0.0006	−0.002***	−0.00009	−0.001**
	(0.0003)	(0.0004)	(0.0006)	(0.0007)	(0.0005)	(0.0005)	(0.0004)	(0.0004)
School percentage current or former English learner	−0.0005	−0.0003	−0.002*	−0.0006	−0.0009	−0.0009	−0.0004	−0.0003
	(0.0005)	(0.0006)	(0.0008)	(0.001)	(0.0007)	(0.0007)	(0.0005)	(0.0006)
School is in a district that contains a *PLC at Work* school	0.020	−0.031	0.039	−0.002	0.028	0.012	0.016	−0.039*
	(0.015)	(0.017)	(0.022)	(0.026)	(0.019)	(0.019)	(0.015)	(0.019)
School percentage ever eligible for special education	0.002	0.002	0.003	0.004	−0.004	−0.004	0.004*	0.003
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
School percentage beginning teachers	−0.034	−0.237***	0.000	−0.201*	0.016	−0.096	−0.015	−0.246***
	(0.046)	(0.053)	(0.070)	(0.082)	(0.061)	(0.061)	(0.047)	(0.057)
Constant	0.088	0.079	0.201*	0.055	−0.202**	-0.044	0.211***	0.200**
	(0.050)	(0.058)	(0.091)	(0.105)	(0.069)	(0.069)	(0.051)	(0.062)
School random effect (constant)	−2.196***	−2.029***	−2.228***	−2.057***	−2.360***	−2.404***	−2.159***	−1.935***
	(0.041)	(0.039)	(0.065)	(0.063)	(0.076)	(0.078)	(0.040)	(0.038)
School random effect (residual)	−0.510***	−0.459***	−0.580***	−0.451***	−0.409***	−0.392***	−0.554***	−0.480***
	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)	(0.002)
N	91156	91156	21841	21841	21205	21205	91792	91792

N cluster	30	30	30	30	30	30	30	30
ll	−83365.1	−88007.4	−18513.7	−21340.9	−21557	−21898.5	−79886.3	−86768.5

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Table C11. Results by eligibility for English learner services

	Current English learner in baseline year		Former English learner in baseline year		Never English learner	
	English language arts (ELA)	Math	ELA	Math	ELA	Math
PLC at Work Cohort 1 school	−0.025	0.095[*]	0.016	0.121	0.056[**]	0.058[**]
	(0.043)	(0.046)	(0.054)	(0.064)	(0.019)	(0.020)
Baseline ELA score (standardized)	0.541[***]	0.302[***]	0.473[***]	0.277[***]	0.600[***]	0.344[***]
	(0.012)	(0.013)	(0.017)	(0.020)	(0.004)	(0.004)
Baseline math score (standardized)	0.236[***]	0.378[***]	0.205[***]	0.497[***]	0.277[***]	0.477[***]
	(0.012)	(0.013)	(0.014)	(0.017)	(0.004)	(0.004)
Special education	-0.312[***]	-0.188[***]	-0.120[***]	-0.086[*]	-0.355[***]	-0.248[***]
	(0.016)	(0.017)	(0.031)	(0.036)	(0.005)	(0.006)
Male	-0.152[***]	0.076[***]	-0.157[***]	0.113[***]	-0.195[***]	0.058[***]
	(0.012)	(0.013)	(0.014)	(0.016)	(0.004)	(0.004)
Asian	0.034	0.115	0.099	0.081	0.014	0.123[***]
	(0.062)	(0.066)	(0.068)	(0.080)	(0.028)	(0.029)
Black	0.003	−0.228	−0.068	−0.315	−0.201[***]	−0.234[***]
	(0.109)	(0.118)	(0.154)	(0.181)	(0.007)	(0.007)
Latinx	−0.085	−0.088	−0.057	−0.176[*]	−0.021[*]	-0.059[**]
	(0.056)	(0.060)	(0.064)	(0.075)	(0.009)	(0.010)
American Indian/Alaska Native	−0.251	−0.242	‡	‡	−0.023	−0.019
	(0.194)	(0.209)			(0.030)	(0.032)
Native Hawaiian/Pacific Islander	−0.114	−0.202[**]	−0.101	−0.231[**]	−0.214[**]	−0.078
	(0.061)	(0.065)	(0.073)	(0.086)	(0.078)	(0.083)
Two or more races	0.040	−0.062	−0.122	0.010	−0.0445[***]	−0.070[***]
	(0.093)	(0.100)	(0.105)	(0.124)	(0.009)	(0.010)
Free or reduced–price lunch	−0.244[***]	−0.263[***]	−0.169[***]	−0.067	−0.125[***]	−0.154[***]
	(0.044)	(0.048)	(0.040)	(0.046)	(0.005)	(0.006)
Baseline grade level (2016/17)	0.024[***]	0.001	0.021[**]	0.025[**]	0.008[***]	0.009[***]
	(0.006)	(0.007)	(0.008)	(0.009)	(0.002)	(0.002)
Gifted and talented	0.594[***]	0.726[***]	0.316[***]	0.412[***]	0.391[***]	0.472[***]
	(0.029)	(0.031)	(0.022)	(0.026)	(0.006)	(0.006)
Suspended or expelled	−0.206[***]	−0.195[***]	−0.203[***]	−0.298[***]	−0.229[***]	−0.204[***]
	(0.017)	(0.018)	(0.026)	(0.030)	(0.005)	(0.006)
Chronically absent	−0.185[***]	−0.189[***]	−0.0709[*]	−0.136[***]	−0.127[***]	−0.167[***]
	(0.021)	(0.023)	(0.032)	(0.037)	(0.006)	(0.007)
Propensity score	2.674	−0.706	3.465[*]	−0.689	0.989	−0.672

	(1)	(2)	(3)	(4)	(5)	(6)
	(1.424)	(1.501)	(1.717)	(2.125)	(0.868)	(1.013)
Northwest	0.033	−0.070	0.089	−0.045	0.035	0.032
	(0.052)	(0.055)	(0.077)	(0.093)	(0.024)	(0.028)
Northeast	0.040	−0.004	0.115	0.023	0.041	0.039
	(0.057)	(0.061)	(0.086)	(0.103)	(0.023)	(0.027)
Central	−0.022	−0.058	0.076	0.039	0.013	0.032
	(0.047)	(0.050)	(0.073)	(0.088)	(0.021)	(0.025)
Southwest	0.081	0.008	0.124	0.030	0.045	0.071[*]
	(0.053)	(0.056)	(0.079)	(0.096)	(0.024)	(0.028)
School enrollment	−0.000002	0.000009	−0.00006	−0.00005	−0.00002	0.000003
	(0.00003)	(0.00003)	(0.00004)	(0.00005)	(0.00002)	(0.00002)
School percentage eligible for free or reduced–price lunch	−0.0002	−0.0005	0.0003	0.0007	0.0003	0.00000
	(0.0009)	(0.0009)	(0.001)	(0.001)	(0.0004)	(0.0004)
School average baseline math score (standardized)	−0.175	0.333[***]	−0.108	0.473[***]	−0.076	0.493[***]
	(0.092)	(0.097)	(0.110)	(0.135)	(0.048)	(0.056)
School average baseline ELA score (standardized)	0.362[***]	−0.045	0.269[*]	−0.156	0.378[***]	−0.069
	(0.090)	(0.095)	(0.110)	(0.136)	(0.048)	(0.056)
School percentage white	0.0001	−0.0009	0.0007	0.00004	−0.0004	−0.001[***]
	(0.0008)	(0.0008)	(0.001)	(0.001)	(0.0003)	(0.0004)
School percentage current or former English learner	−0.001	−0.0004	0.00002	−0.0004	−0.0004	−0.0003
	(0.0009)	(0.001)	(0.001)	(0.001)	(0.0005)	(0.0006)
School is in a district that contains a *PLC at Work* school	0.021	−0.051	0.093[**]	0.022	0.011	−0.031
	(0.026)	(0.027)	(0.030)	(0.037)	(0.015)	(0.017)
School percentage ever eligible for special education	0.001	−0.001	0.006	0.006	0.002	0.002
	(0.004)	(0.004)	(0.005)	(0.006)	(0.002)	(0.002)
School percentage beginning teachers	−0.012	−0.255[*]	−0.135	−0.759[***]	−0.031	−0.230[***]
	(0.114)	(0.121)	(0.147)	(0.178)	(0.045)	(0.052)
Constant	0.025	0.283[*]	0.201	0.230	0.231[***]	0.204[***]
	(0.127)	(0.136)	(0.159)	(0.192)	(0.049)	(0.058)
School random effect (constant)	−2.170[***]	−2.140[***]	−2.070[***]	−1.806[***]	−2.211[***]	−2.030[***]
	(0.095)	(0.097)	(0.110)	(0.096)	(0.041)	(0.039)
School random effect (residual)	−0.590[***]	−0.514[***]	−0.660[***]	−0.502[***]	−0.516[***]	−0.455[***]
	(0.008)	(0.008)	(0.009)	(0.009)	(0.002)	(0.002)
N	9185	9185	5919	5919	97893	97893
N cluster	30	30	29	29	30	30
ll	−7708.7	−8403.5	−4578.1	−5523.1	−88876	−94896.6

[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

Source: Authors' analysis of Arkansas Division of Elementary and Secondary Education data, 2016/17.

Note: ‡ variables omitted because of collinearity.