NW BOCES's System for Educator Effectiveness Development (SEED) Project

Final Evaluation Report

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Executive Summary

In January 2015, the Northwest Board of Cooperative Educational Services (NW BOCES) received a five-year Investing in Innovation (i3) grant to develop and implement the System for Educator Effectiveness Development (SEED) program—an innovative professional development (PD) system designed to provide geographically isolated educators an impactful tool to improve teacher effectiveness. McREL International (McREL) was contracted by NW BOCES to conduct an independent evaluation of SEED.

Twenty-one schools in rural areas, where obtaining PD can be a challenge, participated in SEED between 2015 and 2020. (One of them closed during the study period but the majority of its students transferred to other participating schools.) Because SEED was a school-level intervention, the target population consisted of all principals, assistant principals, teachers, and students in the participating sites.

SEED had six goals. They follow, along with our main findings related to each:

Goal One: Successfully implement and continually improve SEED in up to 30 NW BOCES schools during a four-year period. Some early technological challenges were rapidly overcome, and implementation proceeded largely as planned in all 21 schools. SEED's three components (creation, delivery, and participation) were implemented at a generally adequate level and with planned rigor: Evidence-based PD courses driven by teacher needs and interests were created, followed by an online/blended delivery platform and an online resource repository (i.e., SEED Personalized Accessible Knowledge [SEED PAK]). Teacher participation in SEED courses through the online and blended delivery was a success with high marks to the quality of SEED courses—average ratings ranged from 5.32 to 5.50 on a 6-point scale. Teachers also gave SEED PAK high scores for quality—average ratings ranged from 4.19 to 5.32 on a 6-point scale; yet, the level of SEEK PAK usage was lower than expected. Project staff suspected that the low usage of SEED PAK might due to teachers' preference for human connection while learning.

Goal Two: Increase principal engagement in teacher professional growth and support throughout the project period. Principal engagement (as gauged by teacher and principal surveys) grew markedly over the three years. This was true in both high participation and low participation schools.[1] While causation could not be determined in this study design, these results suggest any teacher in a SEED school, regardless of their personal degree of participation, stands to benefit by having a principal who has grown more attuned to their needs for PD.

Goal Three: Increase rural teachers' access to and use of current best practices and up-to-date content knowledge. Principals agreed that the PD made available to their teachers as a result of SEED was up-to-date and evidence-based—and their level of agreement rose over time. When asked about the extent to which schools offered time and resources to access PD, both principals' and teachers' ratings increased significantly over time. Teachers who used SEED were likelier than

[1] School level SEED participation rates were calculated based on teacher participation data collected in Y3 (2018-19). Schools with equal or more than 50% of teachers who participated in SEED were coded as high-participation schools, while schools with less than 50% of teachers who participated in SEED were coded as low-participation schools.

those who didn't, to say they had access to PD that was up-to-date, evidence-based, data-driven, and easy to access.

Goal Four: Support teachers in successfully implementing SEED practices and content. Several outcomes were used to measure this goal and all of them showed statistically significant increases over time. Additionally, SEED teachers reported more favorable outcomes compared to non-SEED teachers on measures related to knowledge of best practices, though the two groups did not differ in terms of change in classroom practice, such as teacher evaluation ratings and opportunities to collaborate with peers. Similar findings were found when comparing the measures between high-participation and low-participation schools. Due to the study design, causal inference could not be established. Yet, these findings are encouraging as they suggest that SEED participation at the teacher and school levels was associated with teachers' knowledge of best practices and positive change in classroom practices (i.e., teacher perception of SEED impact on their practices).

Goal 5: Improve student achievement. The ultimate goal of SEED was to increase student achievement, and a quasi-experimental study provided some promising evidence that it did. Of six student outcomes we assessed, SEED had a statistically significant positive effect on one (minority students' English language acquisition, or ELA) and marginally significant positive effects on four (all related to English language acquisition and math outcomes among racial/ethnic minority and free and reduced-lunch, or FRL, students). Some caution is advised in interpreting these findings too broadly, as the Colorado Department of Education masks data for subgroups smaller than 16, meaning the subgroups that were available for us to analyze didn't fully represent SEED schools.

Goal 6: Improve student engagement. Student engagement tends to decrease as students age, and this well-documented phenomenon held true in SEED schools as well. We did, however, establish that SEED was associated with less loss of engagement by comparing high-participation schools with low-participation schools. While causation cannot be made due to the nature of the correlational design, the positive association between level of SEED participation and the student engagement measure was encouraging.

Taken together, over one year of planning and pilot testing (2015–16) and four years of full implementation (2016–17 to 2019–20), SEED achieved all six of its goals.

Introduction

In January 2015, the Northwest Board of Cooperative Educational Services (NW BOCES) received a five-year Investing in Innovation (i3)[2] grant to develop and implement the System for Educator Effectiveness Development (SEED) program—an innovative professional development (PD) system designed to provide geographically isolated educators an impactful tool to improve teacher effectiveness.

NW BOCES serves seven school districts (30 schools) with 87% (six out of seven) located in rural areas. Rural areas often have a disproportionate number of new teachers who need additional support as they learn about the profession and their own practices. Additionally, rural teachers are often not adequately prepared to provide supports for high needs students (Gaumer Erickson, Noonan, & McCall, 2012). In the districts served by NW BOCES, about one-third of students (32%) are low-income; 11% are in special education; and 8% are English learners. The need for evidence-based PD to support educators within NW BOCES is evident.

Literature Review

Definitions of evidence-based PD. Evidence-based PD refers to structured professional learning that improves teacher practices and student learning (Darling-Hammond, Hyler, & Gardner, 2017). Accumulated literature has indicated that effective PD often incorporates elements that support peer collaboration and engage educators in collective inquiry through a community of learners (Darling-Hammond et al., 2017; Jaquith, Mindich, Wei, & Darling-Hammond, 2011; Vescio, Ross, & Adams, 2008). Teacher learning communities (TLCs) are examples of such PD model (Vescio et al., 2008). After reviewing 11 studies that reported positive effects of TLCs on teaching and learning, Vescio and colleagues indicate that effective TLCs focus on the significance and nature of teacher collaboration. Within TLCs, professional learning occurs within a collaborative culture in which educators are actively engaged in collective inquiry and act on the knowledge and skills learned. Teacher authority—the ability of teachers to make decisions regarding the processes of their learning communities—is also an important element of effective TLCs that foster changes in teaching cultures and mindsets. Teacher authority empowers teachers to take ownership of their own learning. Lastly, TLCs need to address teachers' need for continuous learning and improvement in their profession (Philipsen, 2019; Vescio et al., 2008). Vescio et al. conclude their review by noting that participation in TLCs impacts teaching practice as teachers become more student-centered and focus on applying the skills and knowledge learned in their teaching. TLCs also improve teaching culture because the learning communities increase collaboration, empower teachers, and support teachers' continuous learning needs. As a result, students benefit from TLCs as indicted by improved achievement scores observed in the literature.

Darling-Hammond et al. (2017) expanded their review on PD studies beyond TLCs, and identified seven shared features of effective PD. First, effective PD is content-focused, job-embedded, and aligned with school and district priorities. Second, active learning is a key ingredient of effective PD as it engages teachers directly in the practices they are learning and is connected to teachers' classrooms and students. As an example, teachers can engage in the same learning activities they are

[2] The i3 grant was funded by the Office of Improvement and Innovation within the U.S. Department of Education.

designing for their students as a form of active learning (Darling-Hammond et al., 2017). Third, collaboration is a common and crucial element of effective TLCs. In Darling-Hammond et al., collaboration includes a host of configurations—from one-on-one or small-group interactions, to schoolwide collaboration, to exchanges with other professionals beyond the school. The authors note that collaborative approaches to PD can be an effective way of promoting school change that extends beyond individual classrooms. Fourth, effective PD often utilizes models of effective practices. Examples of modeling are videos, demonstration lessons, unit or lesson plans, peer observations, and curriculum materials such as sample assessment and student work samples. Fifth, feedback and reflection are two important elements found in effective PD as these practices provide time for teachers to practice, receive feedback, reflect, and make changes to their practice. Sixth, coaching often plays an essential role in facilitating some of the strategies discussed above, such as modeling, collaboration, and feedback and reflection. Lastly, effective PD often requires time and quality implementation, which means PD that is sustained offers multiple opportunities for teachers to engage in learning around a single set of concepts or practices. By returning to PD settings over time, teachers have an opportunity to reflect, refine, and apply their understanding of materials in their classrooms (Darling-Hammond & McLaughlin, 2011).

Challenges faced by rural educators in accessing evidence-based PD. Rural schools and districts tend to be small, and educators, who are often drawn primarily from the local population, have strong attachments and commitments to their communities. This environment would appear to be a natural context for fostering teacher collaboration and finding opportunities to focus on issues and challenges of relevance to the student population (Howley & Howley, 2005). However, research has found that such opportunities are rare due to limited resources and geographic constraints (Gaumer Erickson et al., 2012; Howley & Howley, 2005; Peltola et al., 2017). It is well documented that rural educators, especially those who teach high needs students, often experience professional isolation because there are fewer job-alike educators nearby with whom they can collaborate (Gaumer Erickson et al., 2012; Howley & Howley, 2005). Moreover, rural schools are less likely than nonrural schools to have a local professional development planning team in place, and rural teachers are less likely to have access to PD and are more likely to report scheduling conflicts compared to nonrural teachers (Peltola et al., 2017).

Emerging solutions for rural teachers' PD. To address the challenges faced by rural educators, researchers have explored some innovative alternative approaches to delivering evidence-based PD to geographically isolated teachers through an online or blended learning format. Research in higher education has found that students in online and blended learning conditions performed statistically significantly better than those learning the same materials through traditional face-to-face instruction (Means, Toyama, Murphy, Bakia, & Jones, 2009). Online and blended learning have gained popularity in higher education settings because of their potential to provide learners with the flexibility to access the content at their own time, place, and pace (Means et al., 2009). With rapid development of educational technology, different applications have been developed to support different models of online learning and facilitate personalized learning. For instance, depending on the leaning objectives, some online learning platforms may use asynchronous communication tools (e.g., email, threaded discussion boards) to facilitate learning. Some may apply synchronous technologies (e.g., webinars, chat rooms, videoconferencing) to simulate face-to-face teaching strategies such as delivering lectures and holding meetings with a group of learners. In many cases, online learning incorporate multiple forms of asynchronous and synchronous online interactions to expand and support a community of learners. For instance, synchronous technologies can be applied to simulate face-to-face experiences and facilitate group discussions with groups of learners in

different locations. Synchronous technologies can be applied to engage learners in self-reflection and feedback—strategies that are commonly observed in effective PD.

Research suggests that online instruction results in greater communication and collaboration among class participants, and the effect is sustained beyond the course (Glomb, Midenhall, Mason, & Salzberg, 2009). Online communities of practice also have the potential to improve rural teacher retention by lessening professional isolation among new teachers (Glomb et al., 2009; Herrington, Herrington, Kervin, & Ferry, 2006; Knapczyk, Chapman, Rodes, & Chung, 2001). Gaumer Erickson and colleagues (2012) examined the effect of asynchronous online PD on secondary special education teachers' practice of providing transition services for secondary students. Participants in the study showed increased knowledge and personal capacity to apply research-based practices, and reported implementation of research-based practices within their classrooms. Participants also reported they developed meaningful collaborative relationships with job-alike peers across the country. Gaumer et al. also collected data from nonrural teachers and compared them with rural teachers: The rural teachers, who initially rated their competency in providing transition services much lower, reported a greater gain at the end of the course compared to their nonrural peers.

Blended learning is an instructional model that combines traditional face-to-face learning with online learning. Blended learning focuses on practices that promote personalized learning where learner-centered pedagogy is valued and enacted (Christensen, Horn, & Staker, 2013; Hilliard, 2015). A well-designed blended learning PD course can increase access, flexibility, and mobility for learners; generate interest in self-study for professional improvement; and empower teachers and increase teacher authority (Hilliard, 2015; Philipsen, 2019; Zilinskiene, Malinauskiene, & Smith, 2016). Research on the impact of blended learning PD is limited, but a few exploratory studies provide promising findings (Berger, Eylon, & Bagno, 2008; Bug, 2018; Sinclair & Owston, 2006). For instance, Sinclair and Owston (2006) examined the effects of two one-year blended learning PD courses on teachers' attitudes, knowledge, and classroom practices. They found the programs increased teacher attitudes and content knowledge in the curricular areas and motivated teachers to transform their classroom practices. The blended learning PD also increased teacher collaboration and involvement at the school level, suggesting that the experience contributed to the emergence of communities of practice (Sinclair & Owston, 2006). Furthermore, Mirriahi and colleagues (2015) suggest that a well-designed blended learning course should address three areas, including *resources* (e.g., availability of course resources), activities (i.e., selection of activities for online and face-to-face delivery, technology to meet learners' diverse needs and preferences, online activities to support learning), *support* (i.e., opportunity for interaction, feedback to support learning), and *assessment* (i.e., design of assessment tasks, self and peer assessment). In summary, online and blended learning may be a promising solution to address the PD needs of rural educators.

Engaging principals and teachers in teacher PD. The premise of evidence-based PD is that PD changes teachers' classroom beliefs and practices, which leads to improved student outcomes (Evans, 2014; Guskey, 2002; Philipsen, 2019; Whitworth & Chiu, 2015). To ensure that PD leads to teacher change as well as high-quality PD content and processes, research also highlights the importance of principal and teacher engagement in teacher PD (Koonce, Pijanowski, Bengtson, & Lasater, 2019; Philipsen, 2019; Whitworth & Chiu, 2015). Teacher engagement in teacher PD means that PD should be driven by teacher needs; teachers need to have the need prior to engaging in the actual PD. (The need can be driven by a personal need, or it can be something arising from a policy change or a new initiative.) One approach to ascertaining teacher engagement in teacher PD is to conduct a needs assessment and use data to inform PD content, processes, and designs. Koonce and colleagues (2019) administered a survey with 249 principals from 112 different systems which

revealed that the majority of school principals (72%) reported that their school conducts regular needs assessment to guide planning for teacher PD. In these schools, teachers were involved in the planning process through a professional development council, and teacher choice was valued in the planning process. In contrast, in schools where needs assessment was not part of the PD process, principals generally reported a disconnect between teachers' needs and PD provided.

Principal engagement, on the other hand, not only plays a significant role in the planning and implementation of teacher PD at the school level, but also a key element that facilitates and sustains teacher change as a result of PD (Evans, 2014; Robinson, Lloyd, & Rowe, 2008; Whitworth & Chiu, 2015). Research has documented multiple pathways through which leadership exerts its influence on student achievement. These pathways are centered around teacher attitudes, including commitment, trust, collective efficacy, agency, and academic optimism (Hallinger, Liu, & Piyaman, 2019; Koonce et al., 2019). Robinson, Lloyd, and Rowe (2008) conducted a meta-analytic review of research on school leadership practices that increase student achievement. They reviewed 27 studies focusing on five types of leadership practices: (1) establishing goals and expectations; (2) resourcing strategically; (3) planning, coordinating, and evaluating teaching and the curriculum; (4) promoting and participating in teacher learning and development; and (5) ensuring an orderly and supportive environment. Results of the meta-analysis revealed that leadership practices that promote and participate in teacher learning and development were the most effective strategy to increase student achievement among all other types of leadership practices. Specifically, the average effect size for leadership practices involving promoting and participating in teacher learning and development was 0.84, compared to others with ES ranging from 0.27 and 0.42. Therefore, principal engagement should be a key element of PD programming to strengthen and sustain the impact of PD on teacher change in practice and student learning outcomes (Evans, 2014; Koonce et al., 2019; Whitworth & Chiu, 2015).

SEED Logic Model

Guided by the research on evidence-based PD for rural educators (Darling-Hammond et al., 2017; Gaumer Erickson et al., 2012; Howley & Howley, 2005; Koonce et al., 2019; Vescio et al., 2008), SEED took a systematic approach to addressing the PD needs of *all* educators within the NW BOCES regions. Figure 1 shows SEED's logic model, depicting SEED's strategies to address the needs of rural educators in three components: SEED creation, SEED delivery, and SEED participation.

SEED Strategies	Outputs	Short-term Outcomes	Long-term Outcomes
SEED Creation • Create evidence-based PD driven by teacher needs and interests • Develop a repository of online, up-to-date, evidence-based PD resources aligned with Educator Effectiveness standards **SEED Delivery** • Deliver PD through a dynamic PD platform that enables online PD and blended learning TLC **SEED Participation** • Engage principals and teachers in teacher PD	• SEED strategies were implemented as planned in all SEED schools (Goal 1)	• Increased principal and teacher engagement in teacher PD (Goal 2) • Increased teacher access to evidence-based PD (Goal 3) • Increased teacher application of knowledge and skills learned from PD in classroom (Goal 4) • Improved student engagement (Goal 6)	• Improved student achievement (Goal 5)

Figure 1. SEED Logic Model

Creation of evidence-based PD driven by teacher needs and interest. To engage teachers in PD, it was essential to ensure that PD offered would be not only driven by teachers' interests but also by their needs. The activities envisioned included hiring of Innovative Coaches (ICs) to collaborate with content development teams (CDTs) (i.e., representatives of educators from districts) to identify the topics (i.e., learning strands) for PD offerings. To ascertain that the topics identified address both the needs and interests, data from teacher evaluation ratings would be used to inform areas for improvement and CDTs would receive feedback to incorporate teacher interests. Once the learning strands were identified, ICs would be responsible for developing and designing evidence-based PD. To make it likelier that the PD would improve student achievement and teacher practices, key features of effective PD would be incorporated in all course design and planning (Darling-Hammond et al., 2017; Mishkind, 2014; Vescio et al., 2008).

Delivery of PD through a dynamic PD platform that enables online PD and blended learning TLCs. This strategy would strive to address the accessibility issue that rural educators often encounter. SEED would include various types of evidence-based PD, allowing for greater flexibility in terms of time commitment and travel requirements for rural teachers. Therefore, SEED PD would be delivered in two forms: online PD and blended learning TLCs. All SEED PD offerings would be delivered through a dynamic PD platform, allowing ICs to leverage technology to facilitate SEED PD in a meaningful and effective manner. Additionally, a dynamic PD platform in combination with blended learning TLCs would increase opportunities for NW BOCES teachers

to collaborate across districts, and to access high quality PD resources in ways previously unattainable, especially for those whose teaching role is specific to high need students.

Development of a repository of online, up-to-date, evidence-based PD resources aligned with Educator Effectiveness standards. NW BOCES serves more than 550 educators across seven school districts. To reach and serve *all* teachers, the third strategy was to develop an online platform—Personalized Accessible Knowledge (SEED PAK)—as a central repository of searchable, evidence-based, and high-quality online PD resources that are available and accessible to all teachers 24/7. SEED PAK content would be hand-picked by ICs, who would be responsible for ensuring content is relevant, current, and aligned with the standards specified in the teacher evaluation system (Educator Effectiveness standards).

Engage principals and teachers in teacher PD. Recognizing the importance of engaging principals and teachers in teacher PD, principals and teachers would be encourages to utilize teacher evaluation results to identify appropriate resources from SEED PAK to address each individual teacher's PD needs. Because SEED PAK would be structured to align with each Educator Effectiveness standard, principals would need to be able to easily identify the appropriate PD resources for teachers based on the areas of growth needs. Teachers could also utilize SEED PAK to search for topics of personal interest.

It was hypothesized that, if all elements of SEED were implemented as planned (i.e., high fidelity; Goal 1), SEED would increase principal and teacher engagement in teacher PD (Goal 2); increase teacher access to evidence-based PD (Goal 3); and increased teacher implementation of knowledge and skills learned from PD in classroom (Goal 4). These changes in classroom practice would result in improved student engagement (Goal 5) and then student achievement (Goal 6).

Population Served by SEED

A total of 21 K–12 traditional public schools across seven school districts voluntarily participated in SEED implementation. They included nine elementary schools, three middle schools, three high schools, two elementary and middle schools, three middle and high schools, and one K–12 school. In the 2018–19 school year, one elementary school was closed, and most of its students enrolled in the other two SEED schools within the district. Three schools (14%) were in remote areas, and 18 (86%) in outlying towns or cities where access to high quality PD is often a challenge for educators. Fifteen (71%) schools had student enrollment of less than 400 (i.e., small schools), and six (29%) had student enrollment of 400 or more. The average percentage of minority students across SEED schools was 21%, ranging from 6–41% in 2016. The average percentage of FRL students was 38%, ranging from 17–61%. The average percentage of EL was 12%, ranging from 4–26%. Because SEED was a school-level intervention, the target population to be served by SEED consisted of all principals, assistant principals, teachers, and students.

Table 1 provides the number of principals and assistant principals, teachers, and students across the 21 participating sites by school year.

Table 1. Number of Principals, Assistant Principals, Teachers, and Students by School Year

Participants	2015-16 (Baseline)	Full Implementation			
		2016-17 (Year 1)	2017-2018 (Year2)	2018-19 (Year 3)	2019-20 (Year 4)
Number of principals (assistant principals)	21 (11)	21 (11)	22[a] (10)	21[a] (10)	21[a] (10)
Number of teachers (range per school)	492 (12 – 43)	495 (12-43)	492 (13-44)	502 (12-46)	500 (13-47)
Number of students (range per school)	7,069 (84 – 715)	7180 (141 – 755)	7348 (139-827)	7320 (133-828)	7179 (118-839)

[a] One of the participating schools has two principals.
Source: https://www.cde.state.co.us/cdereval/staffcurrent

Evaluation Overview

The project design involved three phases (see Table 2). Phase I focused on the development of the grant components. Phase II involved pilot testing of TLC components and baseline data collection. Phase III started in the 2016–17 school year and involved full implementation of all four SEED strategies.

Table 2. SEED Project Phases

Phase I	Phase II	Phase III			
Spring 2015	2015–16	2016–17	2017–18	2018–19	2019–20
Development	Pilot testing & baseline data collection	Full Implementation			

McREL International (McREL) was the third-party evaluator for the SEED project. McREL conducted both formative and summative evaluation annually to understand whether and how SEED achieved its project goals as depicted in the logic model (see Figure 1). Formative data were shared with SEED staff to inform continuous program improvement; summative data were analyzed to monitor project progress throughout the project period.

As shown in Table 3, six sets of evaluation questions, including a mix of process (P) and outcome (O) questions, were examined. These questions were organized by project goals and were answered using different research designs (i.e., correlational designs, quasi-experimental design [QED] using propensity score matching methods [PSM]). Mixed methods were conducted to gather data from various groups, including teacher interview (TI), teacher surveys (TS), principal interview (PI), principal survey (PS), IC interviews (ICI), student engagement survey (SES), project records (PR), and extant data (ED). This approach allowed McREL evaluators to use various data sources to gain a comprehensive understanding of how SEED strategies were implemented, and the extent to which SEED achieved its project goals. A detailed technical report of the evaluation plan, including evaluation design, evaluation questions, study samples, data collection methods, and data analysis, appears in Appendix A.

Table 3. Evaluation Questions, Evaluation Design, and Data Collection Method by Project Goal

Evaluation Questions	Evaluation Design			Data Collection Methods
	P	O		
		C	QED	
Goal 1. Successfully implement and continually improve SEED in up to 30 NW BOCES schools during a four-year period (timeliness and continuous improvement)				
a. Are project activities occurring as planned?	X			PR, ICI, PI, PS, TI, TS, TS
b. Is the project maintaining its planned rigor?	X			
c. What barriers and unanticipated outcomes were encountered, and what revisions were made during implementation?	X			
d. What were key project successes during implementation?	X			
Goal 2. Improve principal engagement in teacher professional growth and support				
a. Are principals more engaged in teacher professional growth?		X		PI, PS, TI, TS
b. Are principals able to provide more and better support to teachers through SEED?		X		
c. Do SEED teachers, in comparison with non-SEED teachers, report a higher level of principal engagement in teacher professional growth?*		X		TS
d. What is the relationship between school-level SEED participation rates, and principal and teacher reports of principal engagement in teacher PD?*		X		PS, TS
Goal 3. Increase rural teachers' access to and use of current best practices and up-to-date content knowledge				
a. Are teachers utilizing SEED? Which activities are teachers using? Does use increase over time?	X			PR, TS
b. Is PD reflective of best practices and up-to-date content knowledge?		X		PI, PS, TI, TS
c. Do teachers have time and resources to access PD?		X		
d. Is PD offered to teachers driven by data and does it meet the needs of individual teachers?		X		
e. Do SEED teachers, in comparison with non-SEED teachers, give higher ratings regarding the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is data-driven and aligned with individual needs; and (3) teachers have time and resources to access PD?*		X		PS, TS
f. What is the relationship between school-level SEED participation rates and teachers' ratings on the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is data-driven and aligned with individual needs; and (3) teachers have time and resources to access PD?*		X		PS, TS
Goal 4. Support teachers in successfully implementing SEED practices and content				
a. Does teachers' knowledge of best practices increase?		X		TS
b. Do teachers demonstrate practice change in the classroom?		X		TI, TS, ED
c. Do SEED teachers, in comparison with non-SEED teachers, (1) give higher ratings on their knowledge of best practices, (2) have more opportunity to collaborate with job-alike peers, and (3) have higher teacher evaluation scores?*		X		TS, ED
d. What is the relationship between school-level SEED participation rates and (1) teachers' ratings on their knowledge of best practices, (2) teachers'		X		TS, ED

Evaluation Questions	Evaluation Design			Data Collection Methods
	P	O		
		C	QED	
opportunity to collaborate with job-alike peers, and (3) teacher evaluation scores?*				
Goal 5. Improve student achievement				
a. To what extent do SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation?			X	ED
b. To what extent do students from SEED schools demonstrate an increase in student achievement outcomes over time?*			X	ED
c. To what extent do high-needs students from SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation?			X	ED
d. To what extent do high-needs students from SEED schools demonstrate an increase in student achievement outcomes over time?*			X	ED
e. Do schools with higher levels of teacher participation have higher overall student achievement?*		X		PR, TS, ED
Goal 6. Improve student engagement				
a. Does student engagement increase among participating schools?		X		SES
b. Do schools with higher levels of teacher participation have higher levels of student engagement?*		X		PR, TS, SES

Note. In 2017–18 (grant Year 3), the data collection plan was strategically revised to reduce the redundancy of information collected over time. Specifically, principal, teacher, and IC interviews were removed from the evaluation data collection plan. The teacher survey was revised to include questions related to teacher perceptions of principal engagement in teacher PD that were originally collected through teacher interview.
*Additional questions added in the 2017–18 reporting period.

Purpose and Organization of the Report

The main purpose of this report is to address all questions based on cumulative data collected throughout the project period to understand how the project strategies were implemented; to document the modifications made and reasons for the modifications (Goal 1); and understand the extent to which the project achieved the short- and long-term outcomes depicted in the logic model (see Figure 1, Goals 2–6). Evaluation findings are provided in the following sections organized by project goal.

Evaluation Findings

This section presents findings, by project goal, for the proposed evaluation questions. All data collected throughout the project period were utilized to provide a comprehensive understanding of the processes of project implementation and outcomes achieved throughout the implementation period.

Goal 1: Successfully Implement and Continually Improve SEED in up to 30 NW BOCES Schools During a Four-Year Period

Four questions were examined to understand the extent to which the elements of SEED (creation, delivery, and participation; see Figure 1) were implemented as planned (Goal 1a) and with rigor (Goal 1b). Additionally, as part of the process evaluation, questions related to implementation challenges and successes, as well as modifications made to the implementation plan and for what reason, were also examined (Goals 1c and 1d). Findings from the evaluation follow.

Goal 1a. The project activities were largely completed as planned. Table 4 presents a list of milestones established by the SEED project team during the pilot year and were used as a monitoring tool throughout the implementation period. By the end of the Y4 full implementation, the SEED project team had completed all milestones. Of those completed, < 1% (1 out of 32) were implemented with modification, 1% (3 out of 32) were implemented as planned but with delay, and 1% (4 out of 32) were implemented with modification and delay. The modifications were primarily made to support the development of the SEED PAK platform during the development phase (stage 1).

Table 4. Project Implementation Milestones

Milestone	Deadline	Completed on Time	Completed with Delay	Modified
Initial Planning				
a. Hire part-time lead innovation coach (IC)	Jan. 2015	x		
b. Extend Professional Development & Technology Integration Coordinator's contract to include SEED responsibilities	Jan. 2015	x		
c. Convene the NW BOCES PD Committee	Jan. 2015	x		
d. Contract with McREL	Feb. 2015		X	
e. Contract with technology service providers	Apr. 2015		X	
f. Hire two ICs	Apr. 2015	x		
Stage 1: Technology Development				
a. Initiate the Platform Development Team	Jan. 2015	x		
b. Conference with RANDA Solutions on work plan	Jan. 2015	x		
c. Platform Development Team creates and refines SEED instructional model	Jan. 2015	x		

Milestone	Deadline	Completed on Time	Completed with Delay	Modified
d. Selection rubric for technology vendors created	Feb. 2015	x		
e. Technology vendors selected via competitive RFP process	Mar. 2015	x		
f. First "sandbox" available for Platform Development Team review	May 2015		X	x
g. Team's feedback provided to RANDA Solutions	May 2015	x		
h. Second "sandbox" for team's review	Jun. 2015		X	x
i. Team's feedback provided to RANDA Solutions	Jun. 2015		X	
j. Final Beta SEED platform ready to launch	Fall 2015		X	
k. Monthly and as-needed communication between RANDA Solutions and project leadership team on technology adjustments	Fall 2018		X	x
Stage 2: Content Development and Phased-In Implementation				
a. NW BOCES PD Committee makes determination for 3 initial learning strand topics and subtopics	May 2015	x		
b. Initiate SEED PAK development team	Jun. 2015	x		
c. Innovation Coach training	Jun. 2015	x		
d. Content for one learning stand is ready for Beta deployment	Sept. 2015		X	x
e. Initiate Content Development Teams for 3 learning strands	Oct. 2015	x		
f. Content for all three initial online learning strands is ready for pilot deployment	Jan. 2016	x		
g. Featured resource beta-test with SEED PAK	Feb. 2016	x		
h. Extend Lead Innovation Coach's position to full time	Oct. 2016	x		
i. Additional learning strand(s) determined by the PD Committee [3] and new Content Development Team(s) developed	May 2016–2020	x		
j. Strategies employed to effectively roll out SEED PAK	Mar. 2015–2020	x		
k. Teachers recruited to participate in fall/spring TLC learning strands	May 2016–2020	x		
Stage 3: Content Development and Phased-In Implementation				
a. Completion of SEED facilitation manual	Dec. 2019	x		
b. Training of teacher leaders and principals for continued SEED facilitation	Jan. 2017–2020	x		
c. Development of regional coaches' network for district instructional coaches—incorporating training on using SEED	Aug. 2015–2020	x		
d. BOCES sustainability plan is developed	Jul. 2018	x		

Goal 1b. The project was mostly implemented at an adequate level and with planned rigor.
A fidelity matrix was developed to assess the extent to which the project was being implemented as planned with an adequate level of implementation (see Appendix A, Table A7). Table 5 shows the fidelity score for each fidelity indicator throughout the project period. Key findings from the fidelity matrix are:

- The SEED project team met the adequate level of implementation on all indicators under SEED PD Creation and SEED PD Delivery since Y1 full implementation. The level of

[3] As of 2018, the PD Committee is called the Professional Learning Advisory Group.

implementation on these indicators was consistent and maintained throughout the project period.

- The overall level of implementation on the SEED Participation component was below the desired level. Specifically, the desired threshold for an adequate implementation was 3; yet, by the end of the implementation period, the overall level achieved was 2. As shown in Table B2, two indicators were identified under the SEED Participation component relating to SEED PAK use and SEED course participation. Because this component required buy-in from teachers and principals, it took time to achieve the desired level of implementation. SEED course participation, in particular, took three years to achieve the desired level of implementation. SEED PAK use, on the other hand, was on the right trajectory by the end of Y3 full implementation; however, the level of use declined during the final year of implementation.

Table 5. Fidelity of Implementation Results

Indicators	Definition	Level of Implementation			
		2017 (Y1)	2018 (Y2)	2019 (Y3)	2020 (Y4)
1. Topics for learning strands for PD are selected based on teacher needs.	Learning strands chosen based on teacher needs.	3	3	3	3
2. Evidence-based PD is selected by ICs and CDTs for inclusion on the SEED PAK.	PD activity has a theoretical evidence base.	3	3	3	3
3. ICs and CDTs create in-person TLC activities.	TLCs include at least two in-person activities per semester.	3	3	3	3
4. ICs and CDTs create virtual TLC activities.	TLCs have at least one hour per week of virtual activities.	3	3	3	3
5. ICs format TLC delivery using evidence-based delivery standards.	TLCs utilize the four evidence-based TLC standards from Vescio et al. (2008) model.	3	3	3	3
Score for SEED PD Creation Component (threshold for adequate implementation = 3)		**3**	**3**	**3**	**3**
6. ICs facilitate blended learning TLCs.	TLC is hosted for each learning strand.	3	3	3	3
Score for SEED PD Delivery Component (threshold for adequate implementation = 3)		**3**	**3**	**3**	**3**
7. SEED PD is linked to specific teacher performance indicators by teachers or principals.	Principal or teacher assigns at least one SEED PD in COPMS.	1	1	2	1
8. Teachers complete SEED PD.	Teacher completes at least one facilitated SEED PD (e.g., TLC, Professional Practice Study) OR self-directed completion of at least 8 SEED PAK activities per academic year.	1	2	3	3
Score for SEED Participation Component (threshold for adequate implementation = 3)		**1**	**1.5**	**2.5**	**2**

See Appendix C1 for more details about how the scores were given for each component.

Goal 1c. SEED encountered challenges on the PD Participation components; the team adjusted the implementation plan as necessary to ensure project goals were achieved. As reflected in the findings from the fidelity assessment, the implementation of SEED was largely successful in the areas of SEED PD Creation and SEED PD Delivery. The major challenge was to increase teacher participation in SEED courses as well as increase teacher and principal use of SEED PAK to support teacher PD. To achieve project goals, the project team adjusted its PD course offering plan by expanding SEED course offerings from TLCs to include other types of courses that gave teachers greater flexibility in terms of time commitment and learning modes (i.e., online or hybrid). In its inception, SEED started with offering semester-long blended learning TLCs to teachers. As the project progressed, different types of SEED courses were developed and added. With more-diverse courses available, teachers were able to choose the types of courses that met their unique needs and, as a result, the desired implementation level in terms of teacher participation in SEED courses across SEED schools was reached by the end of Y3 full implementation. Table 6 shows the other non-TLC types of SEED courses offered to teachers throughout the project period.

Table 6. Other Non-TLC SEED Courses

Non-TLC SEED Courses
Professional Practices Studies (PPS; Began in the Spring of 2017)
In response to post-course surveys from PLC participants and feedback from educators across the region, SEED decided to create PPS—a fully online and shorter course offering—that expects teachers to engage in learning over a six-week period and requires only 15 contact hours. With this condensed timeline, it was determined that the guiding learning targets would have to be more finite. Innovation Coaches identified key professional practices in the teacher evaluation rubric to guide the design of the learning. All elements of the original TLCs were present, aside from the ongoing aspect (though one could argue 15 intense hours could be considered ongoing) and blended. So this format differed from TLCs yet still met project goals.
SEED Facilitators Program (Began in the Fall of 2017)
As the ICs became more informed about practices that increase student achievement, teacher leadership was identified as a potential growth area that had yet to be tapped. In the 2016–17 school year, SEED informally began to identify SEED champions, mostly around the SEED PAK, called SEED Gurus. These individuals were culled from content development team (CDT) members and teachers who had participated in a TLC and were trained to support their peers in using SEED PAK. The ICs decided to expand the program beyond just the use of SEED PAK, so every school in the NW BOCES had a designated and informed teacher leader, trained by SEED. The SEED Facilitators were identified by building principals and were paid a $2,000 stipend for their services. Facilitator meetings were much like TLC meetings. They were based on best practice in teacher leadership, collaborative, allowed opportunities for reflection, and were designed to get the heart of our project—enhance student learning and achievement. In addition to these quarterly, all-day, in-person meetings, these leaders were tasked with creating learning opportunities for their peers based on the needs of their staff and students.
Book Studies (Began in the Fall of 2018)
In the second year of the SEED grant, SEED engaged in a design thinking process to identify how to better meet the needs and wants of teachers. After examining the characteristics of SEED participants, it was clear that SEED had a higher level of participation from elementary than secondary teachers. Through the design thinking process, the ICs found that secondary teachers were most interested in PD that was targeted to their content area. Based on that observation, and paired with student achievement data, the first book study was based on Jo Boaler's *Mathematical Mindset*. The book study was a 15-hour commitment, and featured an in-person meeting to begin the learning, coaching, implementation, and reflection expectations. All of the key elements of evidence-based TLCs and best practices in adult learning were applied to the course design. It was a huge success and attracted teachers who had yet to participate in SEED programming. As time went on book studies became fully online, and varied in time commitment, yet were still effective in meeting project goals and purpose.
SEED Independent Study (Began in the fall of 2018)

Non-TLC SEED Courses
This course was created to allow teachers to drive the content of their learning and to bring more users to SEED PAK. Shorter than all other SEED courses at a 7.5-hour time commitment, teachers met with a coach to clarify their goals for their learning and then were expected to complete SEED PAK PD Market resources based on their goals. Participants were also tasked with implementing new practices in their classroom based on the learning, all while being supported by a coach. Many elements of TLCs were present, just in a way that met a teacher's desire for very personalized and targeted learning.
Others
SEED also offers several other types of licensure-based courses/programs to support teachers within NW BOCES, including alt-licensure, induction program, and EL learning modules.

Adoption of SEED PAK was a challenge throughout the life of the grant. The project team consistently strategized and identified new ways to increase use. One way to achieve that was to encourage SEED PAK use through the SEED Facilitators program and SEED Independent studies. After adding these two types of course offerings, there was a noticeable level of increase in SEED PAK usage starting in Y2 (13% of teachers in SEED completed at least one SEED resource), and that level was repeated in Y3. However, the usage level decreased again in Y4. Before concluding the project, the project team reflected on the challenges with implementation of SEED PAK and noted,

> Although SEED PAK was well-designed and stocked with excellent resources connecting to the teacher evaluation rubric, many teachers were just not interested in using it. The design thinking process led us to the conclusion that SEED PAK simply lacked the human connection that teachers craved when learning. Although the level of SEED PAK use was not what we originally hoped for, some teachers find value in it.

Goal 1d. The project was successful in terms of developing and delivering evidence-based and up-do-date PD content. Additionally, with persistence in consistently strategizing and identifying new strategies to engage teachers in SEED PD, the project was able to reach the designed level of implementation on SEED course offerings after three years of implementation. Since project inception, SEED had focused on creating a PD system to support the needs of educators in the rural areas served by NW BOCES. Throughout the years, SEED had created evidence-based PD courses driven by teachers' needs and interests, and developed a repository of online, up-to-date, evidence-based PD resources (i.e., SEED PAK) for all educators within the schools that NW BOCES serves. To ensure that the PD courses met the needs of educators within the NW BOCES region, SEED formed a NW BOCES PD Committee (then the Professional Learning Advisory Group) to determine the topics for SEED offerings based on various data sources, including examining teacher evaluation results, results of teacher and principal surveys, SEED Facilitators' meeting notes, and RANDA self-assessment data. After the topics were defined, content development teams (CDTs) of teachers reviewed draft course syllabi, activities, and resources, and provided feedback that the SEED coaches then incorporated into the course design. With regard to the development and direction for the new learning strands, the process changed slightly over time. During the early stage of the project, each TLC course was considered a learning strand. Starting with Y3 full implementation, the SEED course offerings were intended to be cohesive and to provide teachers with multiple options, in terms of time requirement and learning mode (i.e., a combination of face-to-face and online learning), to build on their growth within the focus strand.

Table 7 presents the comprehensive list of SEED courses throughout the project period as well as number of participants over time. Overall, the enrollment number and completion rate increased annually (by 14%, 63%, and 117% from Y1 to Y2, Y2 to Y3, and Y3 to Y4, respectively). The completion rate also increased annually, from 87% in Y1 to 100% by the end of the implementation period (Y4).

Table 7. Number of Enrollments and Completion Rates of SEED Course Offerings Throughout the Project Period

Facilitated SEED PD	# Recruited	# Completed [a]	Completion Rate
2016-17 School Year			
TLC			
Critical thinking & problem solving	8	8	100%
Developing classrooms of inquiry	10	10	100%
Effective planning for engaging instruction	7	7	100%
Engaging all students in learning	18	14	77.8%
Enhancing classroom instruction through technology integration	13	9	69.2%
Increasing student ownership of learning	22	22	100%
PPS			
Handing thinking over to the students	12	10	83.3%
Others			
Induction program	13	10	76.9%
Alt-licensure program	4	3	75%
Total Number of Unique Teachers[b, c]	**97**	**84**	**86.6%**
2017-18 School Year			
TLC			
Connecting key ideas across content areas	11	10	90.9%
Instructional design to maximize student learning	6	5	83.3%
Increasing student ownership of learning	25	25	100%
Students as partners in creating a positive classroom environment	9	9	100%
Using developmental and cognitive science to enhance instruction	14	14	100%
PPS			
Teaching for cognitive engagement	8	7	87.5%
Using technology for powerful pedagogy	13	8	61.5%
Others			
Induction program	16	13	81.3%
Alt-licensure program	12	11	91.7%
SEED Facilitator	23	23	100%
Total Number of Unique Teachers[b,c]	**111**	**101**	**91.0%**
2018-19 School Year			
TLC			
Access and participation in the thinking classroom	23	23	100%
Connecting key ideas across content areas	8	7	87.5%
Empowering student thinking	22	21	95.5%
PPS			

Facilitated SEED PD	# Recruited	# Completed [a]	Completion Rate
Student engaged revision	9	8	88.9%
Performance-based assessment	7	7	100%
Book Study			
Facilitating teacher teams	14	14	100%
Mathematical Mindsets book study	29	23	79.3%
Supporting beginning teachers	8	6	75%
Independent Study			
SEED independent study	46	44	95.7%
Others			
Alt-licensure program	11	11	100%
Architecture of authentic & relevant learning	13	10	76.9%
EL modules	57	57	100%
Induction program	21	19	90.5%
SEED Facilitator	23	23	100%
Total Number of Unique Teachers[b, c]	**181**	**172**	**95%**
2019-20 School Year			
TLC			
Creating a positive classroom	11	10	90.9%
Enhancing social emotional learning with developmental and cognitive science	23	23	100%
Student collaboration	26	26	100%
PPS			
Critical foundations of formative assessment	10	10	100%
Book Study			
Teaching reading in the content area	9	9	100%
Independent Study			
SEED Independent Study	36	35	97.2%
Others			
Alt-license program	11	10	90.9%
EL Modules	238	231	97.1%
Induction Program	15	14	93.3%
SEED Facilitator	21	21	100%
Total Number of Unique Teachers[b, c]	**392**	**392**	**100%**

[a] Data were provided by the SEED project team. Completion was defined as completion of at least 80% of the course requirements.

[b] The total number of unique teachers was smaller than the sum of the number of teachers recruited for and completing each PD because some teachers participated in more than one SEED PD offering.

[c] Teachers who completed at least one of the SEED courses were counted as completers.

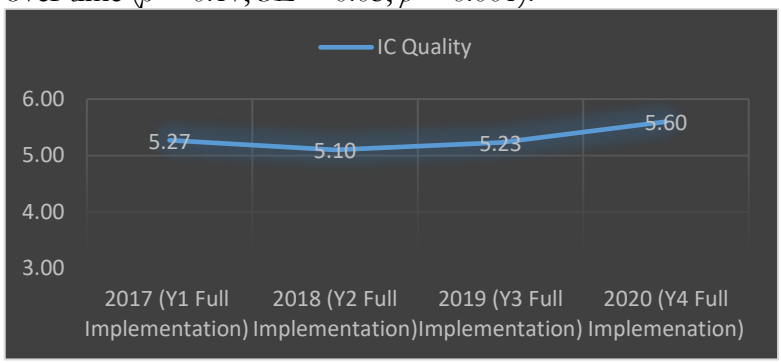
Other noteworthy successes in SEED implementation were:

- ***SEED Facilitator Program develops teacher leaders.*** To support developing teacher leaders, the project hired two external consultants to facilitate some of the SEED facilitator meetings. Feedback received from teachers was positive and hopeful.

> *I feel more empowered as a teacher leader—I came to the conclusion that as a teacher leader it is my role to get involved more to make our teaching better as a collective.*
>
> *I think it was helpful to do the concept map and really put some deep thought into what a teacher leader is. I always enjoy getting opportunities to reflect when I am away from the classroom!* —*SEED Facilitators*

- ***SEED PAK usage increased noticeably in the Y2 and Y3 full implementation years.*** The growth in SEED PAK participation and completion of resources was a success after rolling out the SEED Facilitator program and SEED independent studies. Teachers who participated in the independent studies used SEED PAK resources as their supporting learning materials, which directly impacted the number of teachers utilizing SEED PAK resources. Additionally, SEED Facilitators were encouraged to use SEED PAK resources to engage teachers in their building to access SEED PD.

- ***IC support services were of high quality.*** ICs played a key role in designing, delivering, and implementing SEED courses. When asked about the quality of ICs, teachers spoke highly of the services they received. Figure 2 shows the average ratings over time. Results of latent growth curve (LGC) modeling revealed that the average rating increased significantly over time ($\beta = 0.17$, $SE = 0.05$, $p < 0.001$).



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring IC quality:

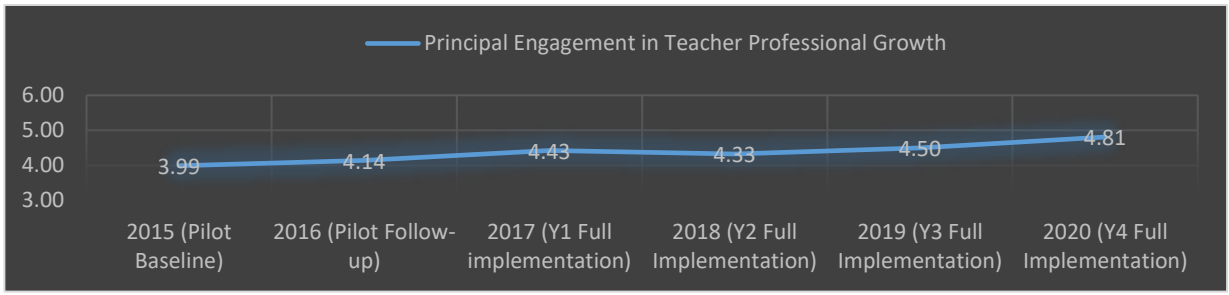
- My IC provided information and resources I needed to support my learning needs and professional goals.
- My IC was available to answer questions.
- My IC was knowledgeable about PD topics.
- Overall, I was satisfied with the quality of the coaching and support I received.

Figure 2. Teacher Perception of IC Quality Over Time

Goal 2. Increase Principal Engagement in Teacher Professional Growth and Support Throughout the Project Period

SEED's second goal was to increase principal engagement in teacher professional growth. Four questions were examined: *Do principals feel more engaged in teacher professional growth (Goal 2a)? Are principals able to provide more and better support to teachers (Goal 2b)? Do SEED teachers, in comparison with non-SEED teachers, report a higher level of principal engagement in teacher professional growth? (Goal 2c)? What is the relationship between school-level SEED participation rates, and principal and teacher reports of principal engagement in teacher PD? (Goal 2d)?* Data were collected from both principals and teachers through online surveys annually. To answer Goals 2a and 2b, a series of latent growth curve (LGC) models was conducted to examine the rate of change on each of the measured constructs over time. School-level means were used in the analyses. To answer Goal 2c, multilevel level modeling was conducted to examine the difference between SEED and non-SEED teachers while accounting for the nesting structure of the data. To answer Goal 2d, linear regression analysis was conducted to examine the difference between High SEED Participation (HP) schools and Low SEED participation (LP) schools.[4] Findings are summarized as follows.

Goal 2a. Both principals and teachers within SEED schools reported an increased level of principal engagement in teacher professional growth over time. Figure 3 shows the average level of principal engagement in teacher professional growth over time based on principal report. Results of LGC revealed that, within SEED schools, principal engagement in teacher professional growth increased significantly over time ($\beta = 0.15$, $SE = 0.03$, $p < 0.001$).



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

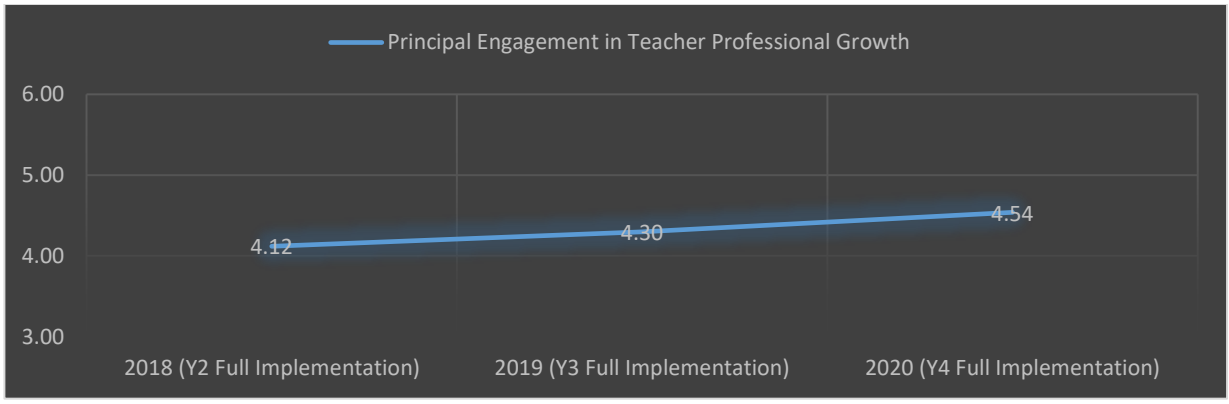
Items measuring principal engagement in teacher professional growth (principal survey):

- In this school, follow-up was provided from PD.
- The PD my school offered was evaluated and results were communicated to teachers.
- Teachers were encouraged to reflect on their own practice.
- The current teacher evaluation systems provide information that allows me to be supportive of teacher PD.
- I understand what PD support teachers need.
- During conversations with teachers regarding their professional growth (i.e., improvement on the teacher evaluation rubric and in knowledge and implementation of best practices), I feel prepared to be supportive.
- Overall, I was satisfied with the quality of the coaching and support I received.

Figure 3. Principal Engagement in Teacher Professional Growth Over Time (Principal Survey)

[4] Definitions of HP and LP schools are provided the Data Analysis Plan section in Appendix A.

Figure 4 shows the average level of principal engagement in teacher professional growth based on teacher report over time. Results of LGC revealed that, within SEED schools, teacher perception of principal engagement in teacher professional growth increased significantly over time ($\beta = 0.19$, $SE = 0.04$, $p < 0.001$).



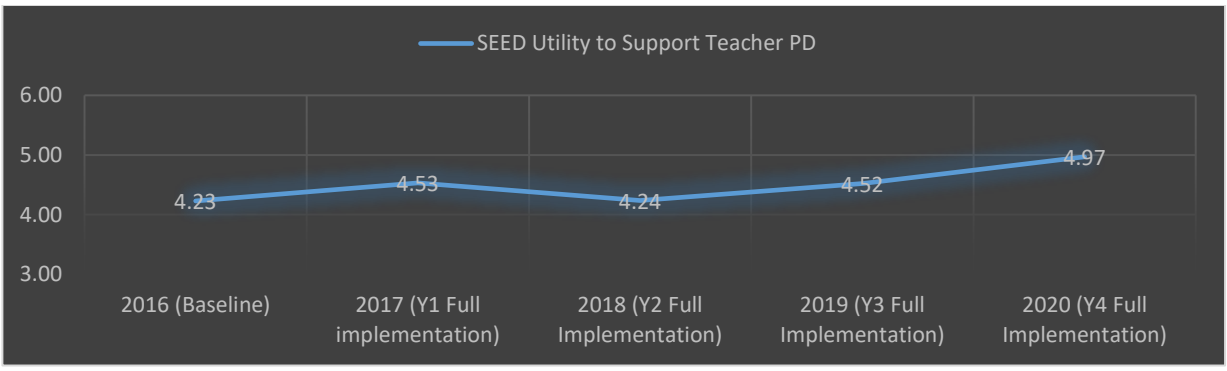
Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring principal engagement in teacher professional growth (teacher survey):

- My principals or supervisor recommended and planned PD based on needs identified through the teacher evaluation process.
- The current teacher evaluation systems in place provide information that allows my principal or supervisor to be supportive of teacher PD.
- My principal or supervisor understands what PD support teachers need.
- During conversations with my principal or supervisor regarding my professional growth (i.e., improvement on the teacher evaluation rubric and in knowledge and implementation of best practices), my principal is supportive.

Figure 4. Principal Engagement in Teacher Professional Growth Over Time (Teacher Survey)

Goal 2b. Both principals and teachers reported that SEED helped principals to provide more and better support for teacher professional growth over time. Figures 5 and 6 show the average level of SEED utility to support teacher professional growth over time based on principal and teacher report, respectively. Results of LGC revealed that, within SEED schools, principal and teacher report of SEED utility to support teacher professional growth increased significantly over time (principal report: $\beta = 0.16$, $SE = 0.05$, $p = 0.003$; teacher report: $\beta = 0.27$, $SE = 0.05$, $p < 0.001$).

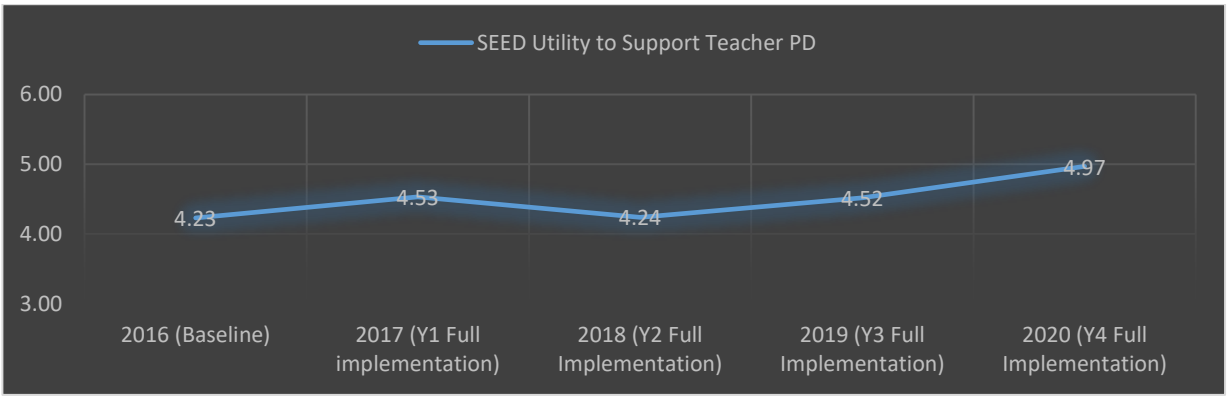


Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring SEED utility to support teachers (principal survey):

- SEED content is useful for teachers' PD.
- The SEED system has PD that is relevant to teachers' needs as identified by the state evaluation rubric (RANDA).
- SEED PD enabled me to support teachers' professional growth.
- The integration of the SEED PAK and RANDA is easy to use.
- The integration of the SEED PAK and RANDA allowed me to better track teacher professional growth plans.
- The integration of the SEED PAK and RANDA helped facilitate conversations with teachers about professional growth.

Figure 5. SEED Utility to Support Teacher PD Over Time (Principal Survey)



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring SEED utility to support teachers (principal survey):

- SEED content is useful for teachers' PD.
- The SEED PD is relevant to my needs.
- The integration of the SEED PAK and RANDA is easy to use.
- The integration of the SEED PAK and RANDA allowed me to better track teacher professional growth plans.
- The integration of the SEED PAK and RANDA helped facilitate conversations with teachers about professional growth.

Figure 6. SEED Utility to Support Teacher PD Over Time (Teacher Survey)

Goal 2c. SEED and non-SEED teachers reported the same level of principal engagement in their professional growth. When comparing the ratings between SEED and non-SEED teachers using Y3 data, there was no difference in terms of teachers' ratings on the level of principal engagement ($\beta = 0.11$, $SE = 0.12$, $p = 0.343$).

Goal 2d. HP and LP schools[5] did not differ in terms of principal engagement in teacher professional growth. Linear regression analyses revealed that HP schools and LP schools did not differ on teacher or principal report of principal engagement (teacher report: $\beta = 0.00$, $SE = 0.13$, $p = 0.999$; principal report: $\beta = -0.27$, $SE = 0.17$, $p = 0.137$).

Findings from Goals 2c and 2d suggest that all teachers might have benefited from SEED regardless of SEED participation status in the area of increased principal engagement in teacher professional growth. However, due to the nature of the correlational design, causal inference cannot be made.

Goal 3. Increase Rural Teachers' Access to and Use of Current Best Practices and Up-to-Date Content Knowledge

SEED was designed to increase rural teachers' access to and use of up-to-date, evidence-based practices (Goal 3). Six questions were addressed: *Are teachers utilizing SEED? Which activities are teachers using? Does use increase over time (Goal 3a)? Is PD reflective of best practices and up-to-date content knowledge (Goal 3b)? Do teachers have time and resources to access PD (Goal 3c)? Is PD offered to teachers driven by data and does it meet the needs of individual teachers (Goal 3d)? Do SEED teachers, in comparison with non-SEED teachers, give higher ratings regarding the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is data-driven and aligned with individual needs; and (3) teachers have time and resources to access PD (Goal 3e)? What is the relationship between school-level SEED participation rates and teachers' ratings on the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is data-driven and aligned with individual needs; and (3) teachers have time and resources to access PD (Goal 3f)?*

For Goal 3a, the SEED participation data collected by the project team throughout the project period were analyzed. For the remaining questions, data collected from the teacher and principal surveys throughout the project period were analyzed. Specifically, to answer Goals 3b, 3c, and 3d, a series of LGC was conducted to examine the rate of change on each of the measured constructs over time. School-level means were used in the analyses. To answer Goal 3e, multilevel level modeling was conducted to examine the difference between SEED and non-SEED teachers while accounting for the nesting structure of the data. To answer Goal 3f, linear regression analysis was conducted to examine the difference between HP and LP schools on the outcomes of interest. Findings are summarized in the following sections.

Goal 3a. Teachers participated in a wide variety of SEED activities, including participating in SEED courses, using SEED PAK resources, and reading SEED blogs. The overall level of participation in SEED courses increased significantly over time. Yet, the level of participation in SEED PAK and reading SEED blogs remained low throughout the project period. Throughout the project period, the SEED project team continued identifying new strategies to increase teacher participation. Over the years, the project team expanded SEED course offerings from one-semester long TLCs to other options that required less time commitment and had greater flexibility in terms of participation modes (i.e., online or hybrid) without compromising quality. Additionally, to reach as many teachers as possible, the project team added writing SEED blogs in their implementation plan as a means to reach a wider audience across the schools that SEED serves. Teacher participation in each type of activities and the quality of the activities are summarized as follows.

[5] See Data Analysis Plan in Appendix A for more detail information regarding the definition of HP schools and LP schools.

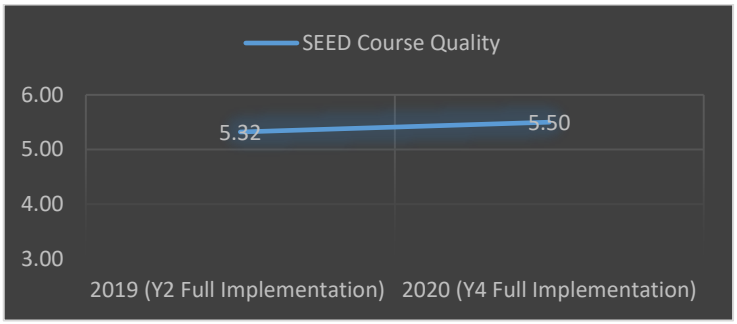
- ***SEED course participation and course quality.*** Overall, SEED course offerings included TLCs, PPS, independent study, book study, and others (e.g., EL modules, Alt-licensure, Induction, SEED Facilitators). Table 8 shows the number of unique teachers who participated in various SEED course offerings throughout the full implementation years. Overall, there were increases of 3%, 14%, and 42% from Y1 to Y2, from Y2 to Y3, and from Y3 to Y4, respectively. The completion rate also increased annually—by the end of Y4 full implementation, 100% of SEED participants had completed at least one SEED course in which they were enrolled. Data on teacher perception of the quality of SEED courses were collected starting with 2019 (Y3 full implementation) via the teacher survey.

Table 8. SEED Courses Enrollment and Completion Rates Over Time

Facilitated SEED PD	# FTE Teachers	# Enrolled	# Completed	Participation Rate	Completion Rate
2016–17 School Year (Y1 full implementation)	495	97	84	19.6%	86.6%
2017–18 School Year (Y2 full implementation)	492	111	101	22.6%	91%
2018–19 School Year (Y3 full implementation)	502	181	172	36.1%	95%
2019–20 School Year (Y4 full implementation)	500	392	392	78.4%	100%

Note. Data were provided by the SEED project team. Completion was defined as a completion of at least 80% of the course requirements. Teachers who completed at least one SEED course were counted as completers.

When asked about the quality of SEED courses, teachers, overall, gave high ratings on the quality of courses in which they participated through the Y3 and Y4 online survey. As shown in Figure 11, the average rating increased over time, and the rate of increase was significant from Y3 to Y4 ($\beta = 1.94$, $SE = 0.22$, $p < 0.001$).



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring the quality of SEED courses:

- SEED courses were a good use of my time.
- SEED courses have useful activities and content.
- SEED courses increased my knowledge of best practices.

Figure 7. Quality of SEED Courses Over Time (Teacher Survey)

- ***SEED PAK usage and quality.*** As shown in Table 9, the number of teachers who completed at least one SEED PAK resource as well as the number of SEED PAK resources completed by teachers increased noticeably from Y1 to Y2 (11 percentage-point increase), and the usage level was maintained in Y3. However, the usage level dropped significantly in Y4 (8 percentage-point decrease). As discussed earlier (see Goal 1 findings), the increase in SEED PAK use in Years 2 and 3 may be the result of the project team's effort to promote use through SEED courses (i.e., independent study, SEED Facilitator program). However,

the low level of SEED PAK use overall may be due to lack of human connection and motivation that teachers desired when learning.

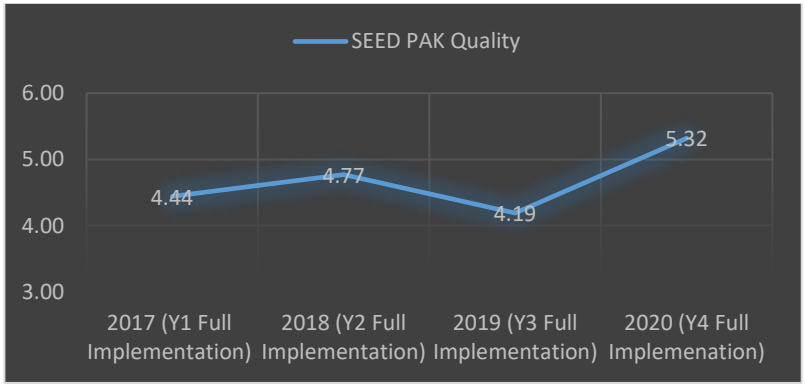
Data on teacher perception of the quality of SEED PAK were collected via teacher survey. When asked about the quality of SEED PAK from teachers who have used it, teachers, on average, gave high ratings. As shown in Figure 8, the average rating increased over time, and the rate of increase was significant ($\beta = 0.23$, $SE = 0.05$, $p < 0.001$).

Table 9. SEED PAK Usage by Year

Year	# FTE Teachers	# of Teachers Completing at least one SEED PAK Resource	SEED PAK Usage Rate	# of Resources Completed
2016–17 School Year (Y1 full implementation)	495	8	1.6%	21
2017–18 School Year (Y2 full implementation)	492	66	13.4%	144
2018–19 School Year (Y3 full implementation)	502	63	12.6%	123
2019–20 School Year (Y4 full implementation)	500	23	4.6%	44

Note. Data source is IC Participation Logs—SEED PAK usage data.

Data on teacher perception of the quality of SEED PAK were collected via teacher survey. When asked about the quality of SEED PAK from teachers who have used it, teachers, on average, gave high ratings. As shown in Figure 8, the average rating increased over time, and the rate of increase was significant ($\beta = 0.23$, $SE = 0.05$, $p < 0.001$).



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring SEED PAK quality:

- SEED PAK activities were a good use of my time.
- SEED PAK has useful activities and content.
- SEED PAK increased my knowledge of best practices.

Figure 8. Quality of SEED PAK Resources Over Time (Teacher Survey)

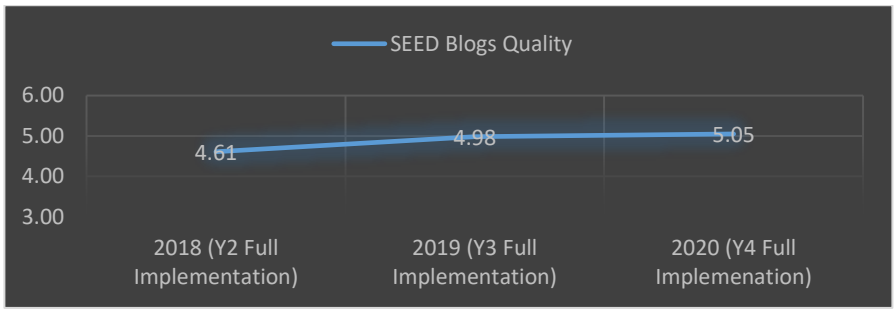
- ***Read the SEED blog and quality of the SEED blog.*** Starting in Y2, The project team decided to start writing blog posts and post them on the SEED PAK platform to reach a wider audience. As shown in Table 10, the number and percentage of teachers who read SEED blogs decreased over time.

Table 10. Number of Teachers Who Read SEED Blogs by Year

Year	# FTE Teachers	Number of Teachers Who Read SEED Blogs	Percentage of Teachers Who Read SEED Blog
2017–18 School Year (Y2 full implementation)	492	107	21.8%
2018–19 School Year (Y3 full implementation)	502	69	13.8%
2019–20 School Year (Y4 full implementation)	500	42	8.4%

Note. Data source is IC Participation Logs—SEED PAK usage data.

Data on teacher perception of the quality of SEED blogs were collected via teacher survey. When asked about the quality of SEED blogs from teachers who have read it, teachers, on average, gave high ratings. As shown in Figure 9, the average rating increased over time, and the rate of increase was significant ($\beta = 0.29$, $SE = 0.07$, $p < 0.001$).



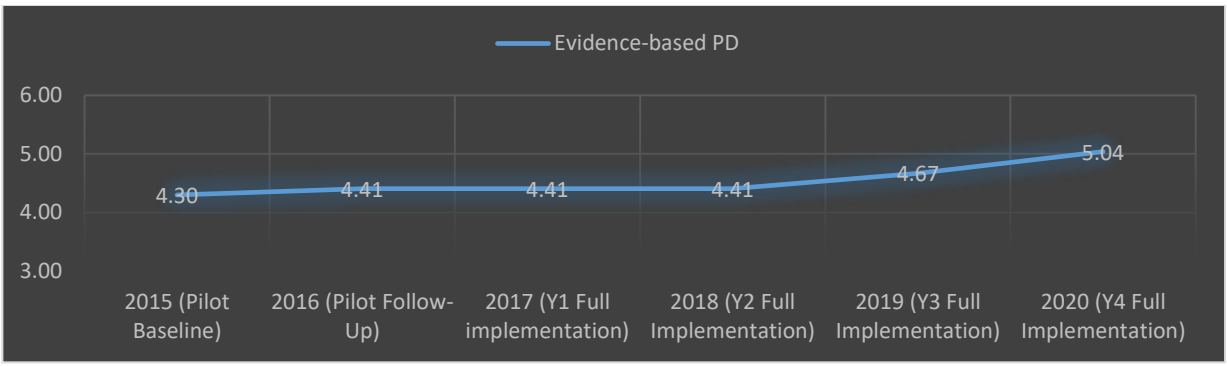
Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring SEED PAK quality:

- Reading the SEED blogs is a good use of my time.
- The SEED blog has useful activities and content.
- The SEED blog increased my knowledge of best practices.

Figure 9. Quality of SEED Blogs Over Time (Teacher Survey)

Goal 3b. Within SEED schools, PD is evidence-based and has up-to-date content. Both principals and teachers provided increased ratings on both constructs over time. Figure 10 shows the extent to which principals perceived PD offered to teachers to be evidence-based. Results of LGC revealed that, within SEED schools, principals' ratings of evidence-based PD increased significantly over time ($\beta = 0.14$, $SE = 0.03$, $p < 0.001$). Yet it should be noted that, within SEED schools, teachers have access to both SEED and non-SEED PD. Therefore, the trend shown in Figure 7 represent principals' perception of all PD (SEED and non-SEED) available to all teachers within SEED schools.



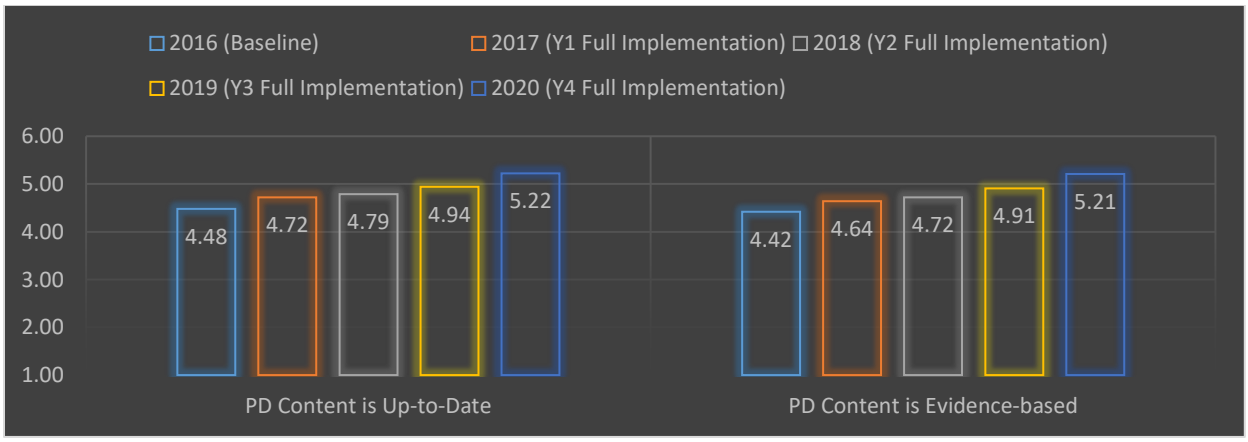
Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring evidence-based PD (principal survey):

- The PD my school offered enhanced teachers' ability to implement instructional strategies that meet diverse student learning needs.
- The PD my school offered provided ongoing opportunities for teachers to work with colleagues to refine teaching practices.
- The PD my school offered enhanced teachers' abilities to improve student learning.
- The professional learning opportunities my school offered were aligned with the school's improvement plan.
- The PD my school offered deepened teachers' content knowledge.
- My school's PD offerings were data-driven.
- I recommended and planned PD based on needs identified through the teacher evaluation process.

Figure 10. Evidence-based PD Over Time (Principal Survey)

Figure 11 shows teachers' perceptions of up-to-date (single item) and evidence-based PD content (single item) over time. Results of LGC revealed that, within SEED schools, teachers' ratings on the extent to which PD content is up-to-date and evidence-based increased significantly (up-to-date PD: $\beta = 0.15$, $SE = 0.02$, $p < 0.001$; evidence-based PD: $\beta = 0.17$, $SE = 0.02$, $p < 0.001$).

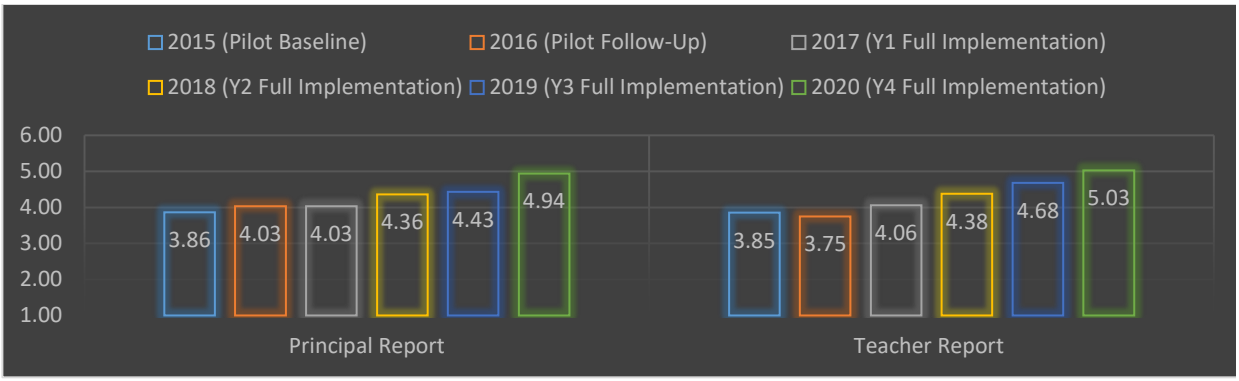


Note. Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6). A mean score was calculated to present the average rating.

Figure 11. Up-to-Date and Evidence-based PD Content Over Time (Teacher Survey)

Goal 3c. Within SEED schools, there was an overall increase in terms of school-provided time and resources to access PD based on both teacher and principal reports. Figure 12 shows principals' and teachers' perceptions, respectively, of time and resources to access PD over time. Results of LGC revealed that, within SEED schools, both principals' and teachers' perceptions

of the extent to which school offered time and resources to access PD increased significantly (principal report: $\beta = 0.19$, $SE = 0.05$, $p < 0.001$; teacher report: $\beta = 0.30$, $SE = 0.04$, $p < 0.001$).



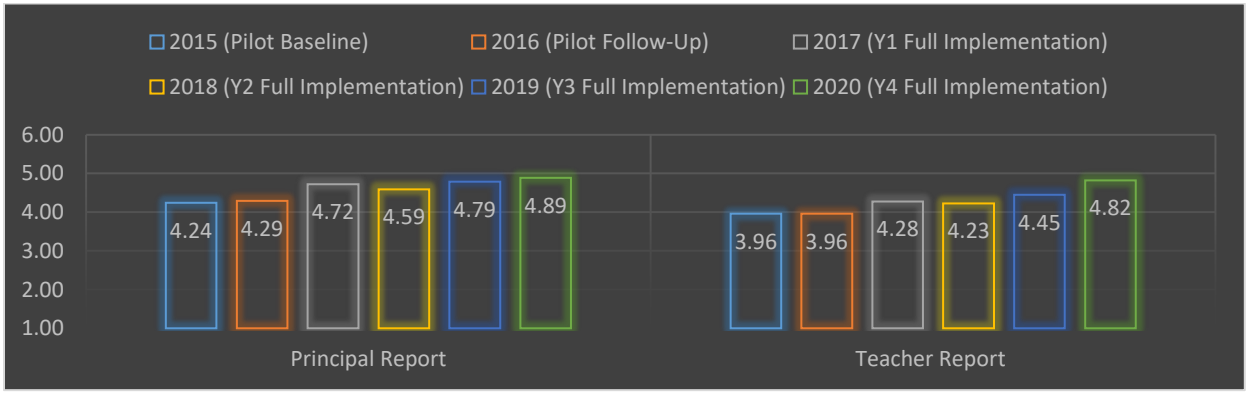
Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring school-provided time and resources to access PD:

- An appropriate amount of time was provided for PD at my school.
- Sufficient resources were available for PD in my school.

Figure 12. School-Provided Time and Resources to Access PD

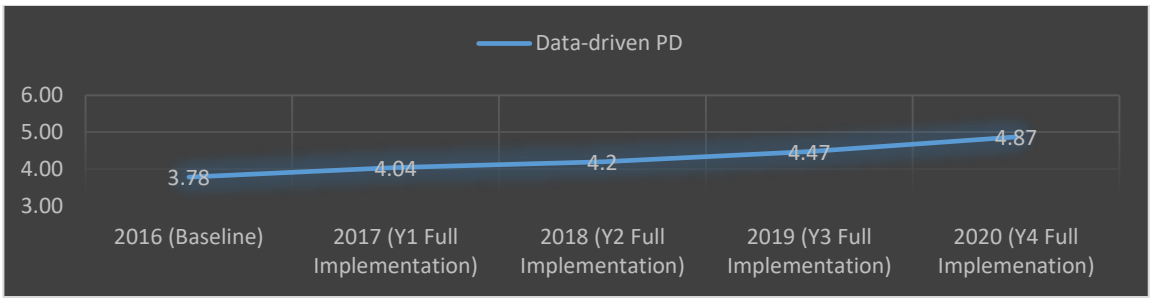
Goal 3d. Within SEED schools, there was an overall increase in principal and teacher report of school-offered individualized teacher PD. Additionally, teachers' ratings on the extent to which PD offered by the school was driven by data increased over time. Figure 13 shows principal and teacher perception of school-offered individualized teacher PD (single item), respectively, over time. Results of LGC revealed that, within SEED schools, both principals' and teachers' ratings on school-offered individualized teacher PD increased significantly over time (principal report: $\beta = 0.17$, $SE = 0.05$, $p < 0.001$; teacher report: $\beta = 0.32$, $SE = 0.08$, $p < 0.001$).



Note. Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6). A mean score was calculated to present the average rating.

Figure 13. My School Offered Differentiated PD Over Time

Figure 14 shows the average rating of teacher perception of the extent to which the PD offered is driven by data over time. Results of LGC revealed that, within SEED schools, teachers' ratings of data-driven PD increased significantly over time ($\beta = 0.23$, $SE = 0.03$, $p < 0.001$).



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring data-driven PD:

- The professional learning opportunities I was offered were aligned with my school's improvement plan.
- The PD I was offered was data-driven.
- Teachers were encouraged to reflect on their own practice.
- School leadership recommended and planned PD based on needs identified through the teacher evaluation process.
- In my school, follow-up was provided from PD.
- The PD my school offered was evaluated and results were communicated to teachers.

Figure 14. Data-driven PD Over Time (Teacher Survey)

Goal 3e. SEED teachers reported more favorable outcomes compared to non-SEED teachers in terms of constructs related to access to and use of up-to-date and evidence-based PD. When comparing the ratings of SEED and non-SEED teachers, SEED teachers gave higher ratings on the following constructs:

- Up-to-date PD ($\beta = 0.33$, $SE = 0.13$, $p < 0.001$)
- Evidence-based PD ($\beta = 0.31$, $SE = 0.11$, $p = 0.007$)
- School-provided time and resources to access PD ($\beta = 0.67$, $SE = 0.13$, $p < 0.001$)
- Data-driven PD ($\beta = 0.60$, $SE = 0.10$, $p < 0.001$).

Due to the nature of the correlational design (non-matched groups), causal inference cannot be made. Yet, these findings altogether are encouraging as they suggest that SEED participation was associated with teachers' ratings on the extent to which the PD they received was up-to-date, evidence-based, and data-driven, as well as whether schools offer time and resources to access PD.

Goal 3f. HP schools, on average, had some favorable outcomes compared to LP schools in terms of constructs related to access to and use of up-to-date and evidence-based PD. When comparing the school-level ratings between HP and LP schools, HP schools had higher ratings on the following constructs:

- Up-to-date PD ($\beta = 0.28$, $SE = 0.12$, $p = 0.027$)
- Data-driven PD ($\beta = 0.33$, $SE = 0.13$, $p = 0.023$)

On the other hand, HP and LP schools did not differ on the following constructs:

- Evidence-based PD ($\beta = 0.22$, $SE = 0.14$, $p = 0.138$)
- School-offered time and resources to access PD ($\beta = 0.30$, $SE = 0.16$, $p < 0.087$)

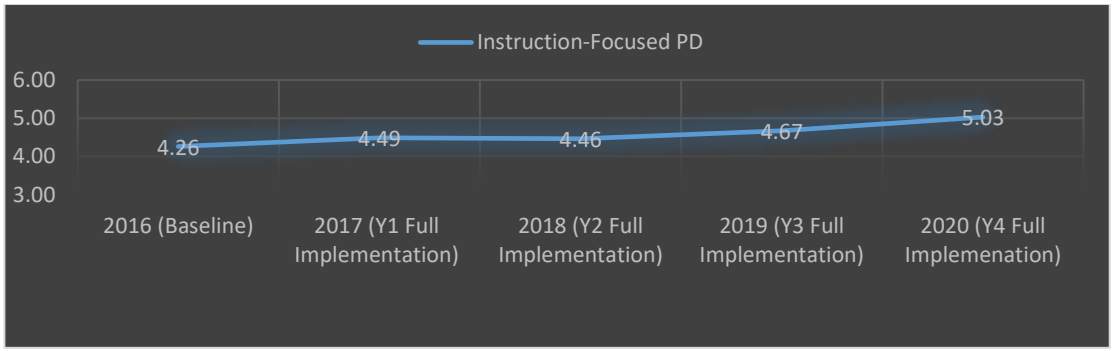
Due to the nature of the correlational design (non-matched groups), causal inference cannot be made. Yet, these findings altogether are encouraging as they suggest that SEED participation at the teacher and school levels was mostly associated with teachers' access to and use of up-to-date PD, and the PD provided was driven by data based on individual needs.

Goal 4. Support Teachers in Successfully Implementing SEED Practices and Content

Goal 4 of SEED was to support teachers' implementation of knowledge and practices learned from SEED in the classroom. Four questions were addressed: *Do teachers' knowledge of best practices increase (Goal 4a)? Do teachers demonstrate practice change in the classroom (Goal 4b)? Do SEED teachers, in comparison with non-SEED teachers, give higher ratings on their knowledge of best practices, (2) have more opportunity to collaborate with job-alike peers, and (3) have higher teacher evaluation scores (goal 4c)? What is the relationship between school-level SEED participation rates and (1) teachers' ratings on their knowledge of best practices, (2) teachers' opportunity to collaborate with job-alike peers, and (3) teacher evaluation scores (Goal 4d)?*

Data collected from the teacher and principal surveys throughout the project period were analyzed. To answer Goals 4a and 4b, a series of LGC was conducted to examine the rate of change on each of the measured constructs over time. School-level means were used in the analyses. To answer Goal 4c, multilevel level modeling was conducted to examine the difference between SEED and non-SEED teachers while accounting for the nesting structure of the data. To answer Goal 4d, linear regression analysis was conducted to examine the difference between HP and LP schools on the outcomes of interest. Findings are summarized in the following sections.

Goal 4a. PD increased teacher report of knowledge of best practices in terms of instruction and learning increased over time. This goal was measured by the extent to which PD increased teachers' knowledge of best practices—instructional practice-focused PD and student learning-focused PD. Figure 15 shows the average rating of teacher perception of the extent to which the PD offered increased their instructional practice over time. Results of LGC revealed that, within SEED schools, teacher report of instructional-focused PD increased significantly over time ($\beta = 0.16$, $SE = 0.02$, $p < 0.001$).



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

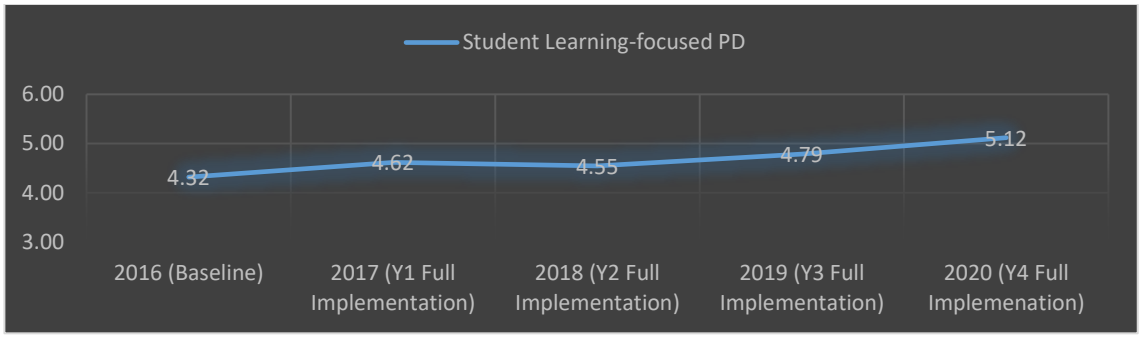
Items measuring instructional-focused PD:

- I learned new and different ideas from my PD experiences.
- The PD improved my knowledge of instructional strategies.
- Knowledge gained from the PD improved my teaching skills.
- The PD increased my enthusiasm for teaching.
- The PD encouraged me to reflect on aspects of my teaching.
- The PD gave me useful ideas of how to improve student outcomes.
- The PD updated my professional knowledge.
- The PD I was offered deepened my content knowledge.
- The PD I was offered was differentiated to meet my individual needs.

Figure 15. Instructional-Focused PD Over Time (Teacher Survey)

Figure 16 shows the average rating of teacher perception of the extent to which the PD offered supports student learning over time. Results of LGC revealed that, within SEED schools, school-

level mean of teacher report of student learning-focused PD increased significantly over time (β = 0.16, SE = 0.02, $p < 0.001$). When comparing the ratings between SEED and non-SEED teachers using Y3 data, SEED teachers gave higher ratings on the construct compared to non-SEED teachers (β = 0.58, SE = 0.11, $p < 0.001$).



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

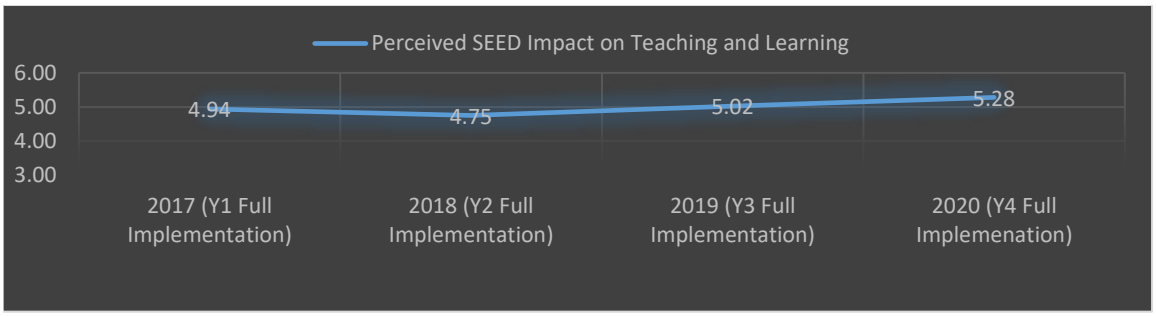
Items measuring student-learning focused PD:

- The PD I was offered enhanced my ability to implement instructional strategies that meet diverse student learning needs.
- The PD I was offered provided ongoing opportunities for me to work with colleagues to refine teaching practices.
- The PD I was offered enhanced my abilities to improve student learning.

Figure 16. Student Learning-focused PD Over Time (Teacher Survey)

Goal 4b. Teachers demonstrated practice change in the classroom as a result of SEED based on teacher report. Through the online survey, teachers answered several questions related to this topic. They were (1) teacher perception of SEED's impact on teacher instruction and student learning; (2) teacher application of what was learned from SEED in the classroom; (3) teacher perception of SEED's impact on collaboration practice; and (4) opportunities to collaborate with peers. Teacher evaluation ratings were also analyzed. Findings are summarized as follows.

- ***Teachers' perceptions of SEED impact on teaching and learning increased over time.*** Figure 17 shows the average rating of teachers' perceived SEED impact on teaching and learning over time. Only SEED participants (see the definition of SEED participants in Appendix A) responded to the questions. Results of LGC revealed that the school-level ratings from SEED teachers increased significantly over time (β = 0.15, SE = 0.05, p = 0.004).



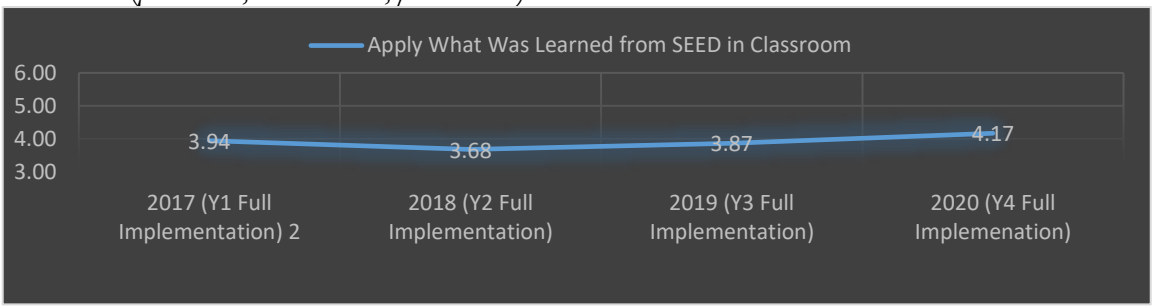
Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring the perceived SEED impact on teaching and learning:

- What I learned from SEED taught me how to implement effective strategies in my classroom.
- SEED content is directly relevant to teaching and learning in my school.
- I use the knowledge gained from SEED in my work with students.
- I am able to put into practice the ideas presented in SEED.
- SEED has improved student learning in my classroom.
- SEED has provided me with knowledge and skills to support high-needs students.

Figure 17. Perceived SEED Impact on Teaching and Learning Over Time (Teacher Survey)

- ***Teacher application of what was learned from SEED in the classroom increased over time.*** Figure 18 shows the average rating of teachers' applications of what was learned from SEED in the classroom. Only SEED participants responded to these questions. Results of LGC revealed that the school average ratings from SEED teachers increased significantly over time ($\beta = 0.10$, $SE = 0.04$, $p = 0.026$).

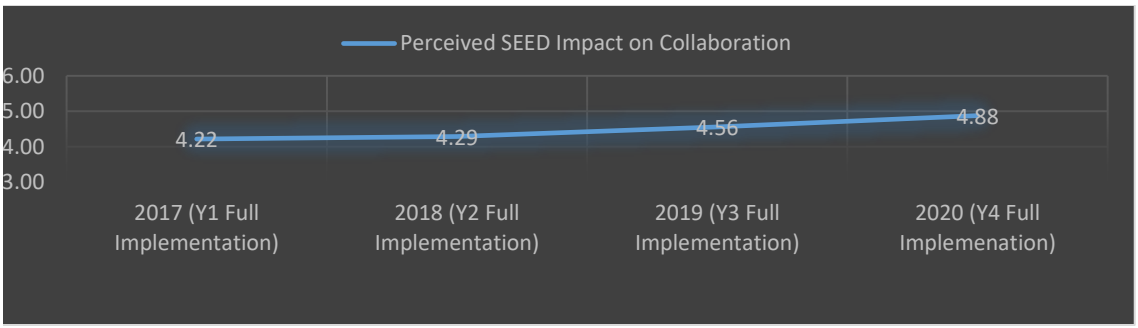


Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Figure 18. Apply What Has Been Learned from SEED in Classrooms[6] Over Time (Teacher Survey)

- ***Teachers' perceptions of SEED's impact on collaboration practice increased over time.*** Figure 19 shows the average rating of teachers' perceived SEED impact on collaboration practice over time. Only SEED participants responded to these questions. Results of LGC revealed that the school average ratings from SEED teachers increased significantly over time ($\beta = 0.25$, $SE = 0.03$, $p < 0.001$).

[6] The construct was measured by one item—*On average, how often do you apply what you have learned in SEED in your classrooms?*



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Items measuring the perceived SEED impact on teaching and learning:

- SEED has encouraged teachers to share what they learned with their colleagues.
- My school provided opportunities for teachers to share information gained from SEED with colleagues.
- Teachers in my school took advantage of opportunities to share ideas, knowledge, and skills gained from SEED.
- SEED involved collaboration with teachers from other schools who teach at the same grade level and/or content area.

Figure 19. Perceived SEED Impact on Collaboration Practice Over Time (Teacher Survey)

- ***Teacher evaluation ratings increased over time.*** Teacher evaluation scores were calculated using the raw score from the teacher evaluation rubric.[7] Figure 18 shows the average teacher evaluation scores over time. Results of LGC revealed that, within SEED schools, teachers' evaluation scores, on average, increased significantly over time. ($\beta = 0.02$, $SE = 0.002$, $p < 0.001$).

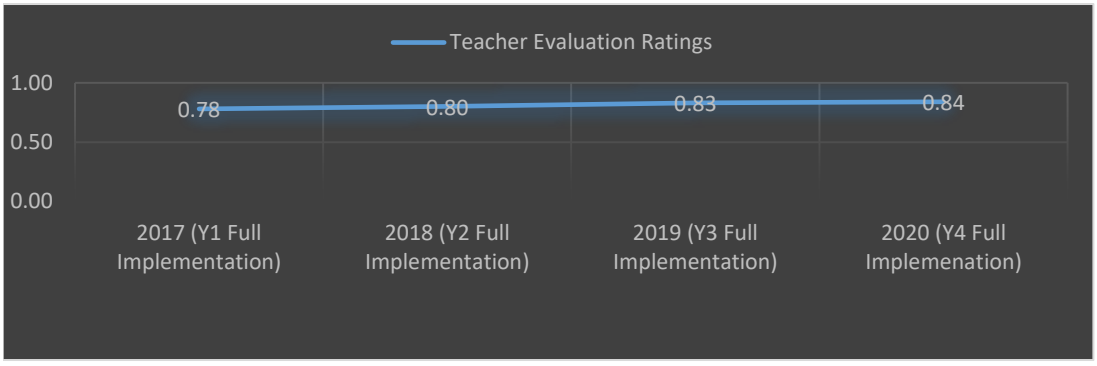
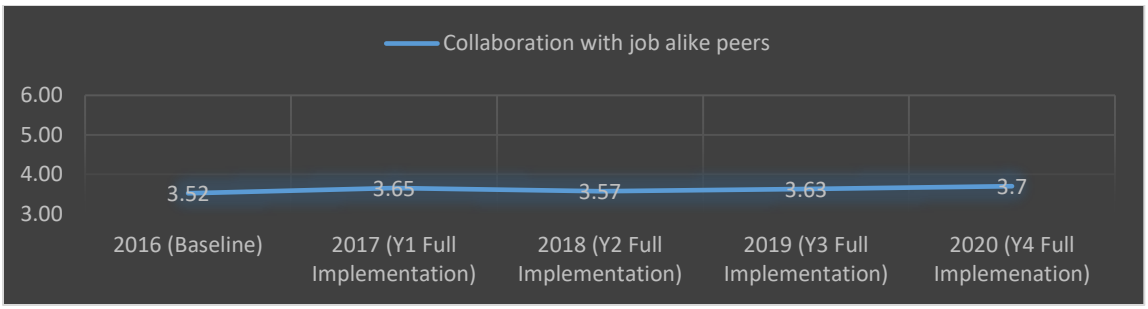


Figure 20. Teacher Evaluation Ratings Over Time

- ***Teacher reports of opportunities to collaborate with job-alike peers increased.*** Figure 19 shows the average teacher ratings of opportunities to collaborate with job-alike peers over time. Results of LGC revealed that, within SEED schools, teacher reports of the opportunities to collaborate with job-alike peers increased significantly over time ($\beta = 0.23$, $SE = 0.03$, $p < 0.001$).

[7] The teacher evaluation score was calculated by using the total number of practices present (i.e., each practice was counted as 1 point) divided by the total number of practice points possible. A higher score means more desired practices present in the evaluation process. Data from the 2019–20 school year were not available due to the interruption of the COVID-19 pandemic.



Item scale—Each item was rated on a 6-point Likert-type scale, with the responses ranging from *strongly disagree* (1) to *strongly agree* (6).

Figure 21. Opportunity to Collaborate With Job-Alike Peers[8] Over Time

Goal 4c. SEED teachers reported more favorable outcomes compared to non-SEED teachers in terms of constructs related to knowledge of best practices. SEED teachers and non-SEED teachers did not differ in terms of demonstration of change in practice in the classroom. When comparing the ratings of SEED and non-SEED teachers using Y3 data, SEED teachers provided higher ratings on the following constructs:

- Instructional practice focused PD ($\beta = 0.67$, $SE = 0.12$, $p < 0.001$)
- Student learning focused PD ($\beta = 0.58$, $SE = 0.11$, $p < 0.001$)

Based on teacher self-reports, SEED seemed to have a positive effect on teachers' practice in classrooms as measured by the constructs of perceived impact on teaching and learning, perceived impact on collaboration, and application of practices learning from SEED to practice. However, when examining the difference on teacher evaluation ratings between SEED and non-SEED teachers, there was no statistically significant difference between the groups ($\beta = 0.01$, $SE = 0.01$, $p = 0.320$). The opportunity to collaborate with peers also did not differ between the groups ($\beta = 0.11$, $SE = 0.11$, $p = 0.348$).

Goal 4d. HP schools, on average, had some favorable outcomes compared to LP schools in terms of constructs related to knowledge of best practices. HP and LP schools did not differ in terms of demonstration of change in practice in classrooms. When comparing the school-level ratings between HP and LP schools, HP schools had higher ratings on the following constructs:

- Instructional practice focused PD ($\beta = 0.31$, $SE = 0.09$, $p = 0.003$)
- Student learning focused PD ($\beta = 0.31$, $SE = 0.10$, $p = 0.005$)

HP and LP schools did not differ in terms of teacher ratings ($\beta = 0.003$, $SE = 0.03$, $p = 0.917$) or the opportunities to collaborate with peers ($\beta = 0.20$, $SE = 0.20$, $p = 0.343$).

Due to the nature of the correlational design, causal inference cannot be made. Yet, findings from Goals 4c and 4d are encouraging as they suggest that SEED participation at teacher and school levels were mostly associated with teachers' knowledge of best practices as well as perceived impact on practices.

[8] This construct was measured by one item.

Goal 5. Improve Student Achievement

Goal 5 of SEED is to increase student achievement. Five questions were addressed: *To what extent do SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation (Goal 5a)? To what extent do students from SEED schools demonstrate an increase in student achievement outcomes over time (Goal 5b)? To what extent do high-needs students from SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation (Goal 5c)? To what extent do high-needs students from SEED schools demonstrate an increase in student achievement outcomes over time (Goal 5d)? Do schools with higher levels of teacher participation have higher student achievement (Goal 5e)?*

Publicly available data between 2015–16 and 2018–19 from the Colorado Department of Education website were used in the analysis. To answer Goals 5a and 5c, regression analyses were conducted to examine the difference between SEED schools and their matched non-SEED[9] schools at the end of Y1, Y2, and Y3, respectively. To answer Goals 5b and 5d, conditional LGC models were conducted to examine the rate of change over time while controlling for baseline covariates. These questions were addressed using QED design with six study samples (see Evaluation Design section under Appendix A for more information about the study samples):

- Study sample 1: All students with ELA outcome
- Study sample 2: Minority students with ELA outcome
- Study sample 3: FRL students with ELA outcome
- Study sample 4: All students with Math outcome
- Study sample 5: Minority students with Math outcome
- Study sample 6: FRL students with Math outcome

To answer Goal 5e, regression analyses were conducted to examine the differences in achievement outcomes between HP and LP schools. Findings are summarized in the following sections.

Goal 5a. SEED had a marginally significant effect on student ELA scores by the end of Year 3. A series of regression analyses was conducted to examine the impact of SEED on students' reading and math outcomes by the end of Y1, Y2, and Y3, respectively. The detailed statistical outputs are provided in Appendix C. One positive finding was found:

- SEED had a marginally significant effect on student ELA outcome by the end of Y3 (β = 0.10, SE = 0.05, p = 0.052). The effect size was 0.10.

Other null findings are summarized as follows:

- SEED and non-SEED schools did not differ on student ELA outcome by the end of Y1 (β = 0.04, SE = 0.04, p = 0.263). The effect size was 0.04.
- SEED and non-SEED schools did not differ on student ELA outcomes by the end of Y2 (β = 0.06, SE = 0.05, p = 0.197). The effect size was 0.06.
- SEED and non-SEED schools did not differ on student math outcome by the end of Y1 (β = 0.04, SE = 0.04, p = 0.337). The effect size was 0.04.
- SEED and non-SEED schools did not differ on student math outcomes by the end of Y2 (β = 0.02, SE = 0.04, p = 0.634). The effect size was 0.02.

[9] The matching methods and processes are reported in detail in the Study Sample section in Appendix A.

- SEED and non-SEED schools did not differ on student math outcomes by the end of Y3 ($\beta = 0.03$, $SE = 0.05$, $p = 0.634$). The effect size was 0.03.

Goal 5b. SEED schools maintained the same level of ELA scores over time, while non-SEED schools showed a statistically significant decline on ELA scores over time. Both SEED and non-SEED schools showed a minor decline (not statistically significant) in math outcomes over time. Figures 20 and 21 show the unadjusted SEED schools' average ELA and math scores, respectively, over time.

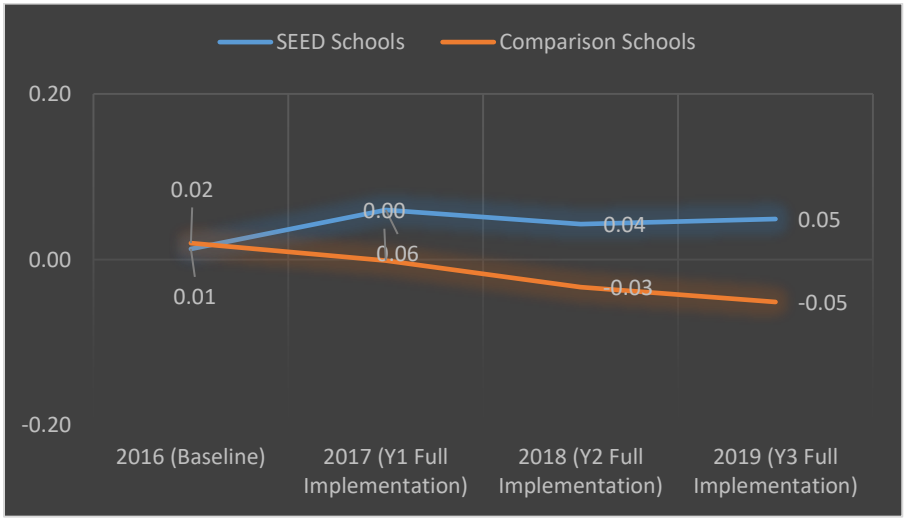


Figure 22. SEED and Non-SEED Schools' Unadjusted Mean ELA Scores Over Time

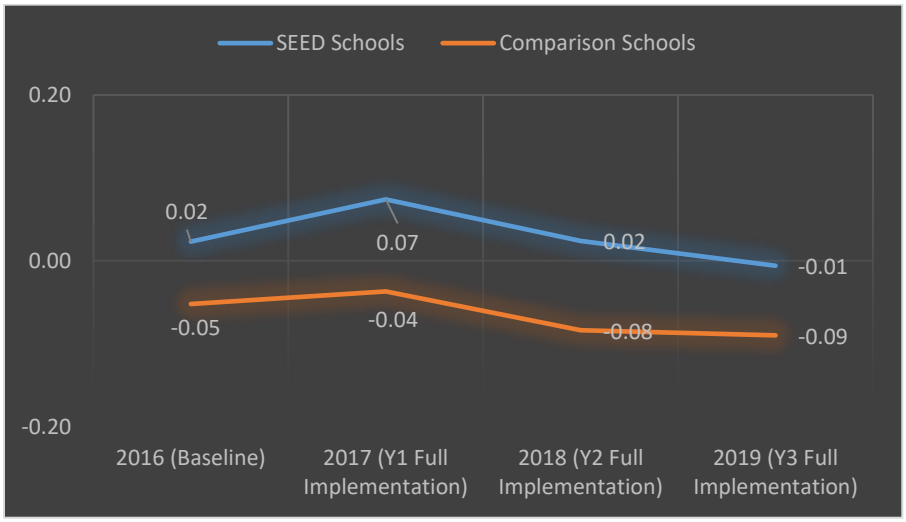


Figure 23. SEED and Non-SEED Schools' Unadjusted Mean Math Scores Over Time

A series of multilevel models was conducted to examine if the rate of change in achievement, if any, differed by group.[10] Key findings are summarized below:

[10] All covariates used in the matching were also included in the analyses.

- Non-SEED schools demonstrated a significant rate of decrease in ELA outcomes over time (β = -0.02, SE = 0.01, p = 0.004), and the rate of change was marginally different between SEED and non-SEED schools (β = 0.03, SE = 0.02, p = 0.078). In other words, while non-SEED schools seemed to decline in ELA outcomes over time, SEED schools seemed to maintain a consistent level of achievement over time.
- Non-SEED schools demonstrated a marginal rate of decrease in math outcomes over time (β = -0.01, SE = 0.01, p = 0.071), and the rate of change was not different between SEED and non-SEED schools (β = 0.00, SE = 0.02, p = 0.964). In other words, both SEED and non-SEED schools seemed to have a minor decline in math outcomes over time.

Goal 5c. SEED increased minority students' ELA outcome by the end of Y1. SEED also had marginally significant effects on minority students' math outcome by the end of Y1, and FRL students' ELA and math outcomes by the end of Y2. A series of regression analyses was conducted to examine the impact of SEED on minority and FRL students' reading and math outcomes by the end of Y1, Y2, and Y3, respectively. The detailed statistical outputs are provided in Appendix C. Four positive findings were found:

- SEED had a statistically significant effect on minority students' ELA outcomes by the end of Y1 (β = 0.20, SE = 0.06, p = 0.002). The effect size was 0.20.
- SEED had a marginally significant effect on FRL students' ELA outcomes by the end of Y2 (β = 0.08, SE = 0.04, p = 0.054). The effect size was 0.08.
- SEED had a marginally significant effect on minority students' math outcomes by the end of Y1 (β = 0.09, SE = 0.05, p = 0.072). The effect size was 0.09.
- SEED had a marginally significant effect on FRL students' math outcomes by the end of Y2 (β = 0.09, SE = 0.05, p = 0.099). The effect size was 0.09.

Other null findings are summarized as follows:

- Minority students within SEED schools and minority students within non-SEED schools did not significantly differ on ELA outcome by the end of Y2 (β = -0.01, SE = 0.07, p = 0.933). The effect size was 0.01.
- Minority students within SEED schools and minority students within non-SEED schools did not significantly differ on ELA outcome by the end of Y3 (β = 0.04, SE = 0.07, p = 0.581). The effect size was 0.04.
- FRL students within SEED schools and FRL students within non-SEED schools did not significantly differ on ELA outcome by the end of Y1 (β = 0.07, SE = 0.05, p = 0.184). The effect size was 0.07.
- FRL students within SEED schools and FRL students within non-SEED schools did not significantly differ on ELA outcome by the end of Y3 (β = 0.03, SE = 0.05, p = 0.564). The effect size was 0.03.
- Minority students within SEED schools and minority students within non-SEED schools did not significantly differ on math outcome by the end of Y2 (β = 0.03, SE = 0.06, p = 0.656). The effect size was 0.03.
- Minority students within SEED schools and minority students within non-SEED schools did not significantly differ on math outcome by the end of Y3 (β = 0.11, SE = 0.07, p = 0.152). The effect size was 0.11.

- FRL students within SEED schools and FRL students within non-SEED schools did not significantly differ on ELA outcome by the end of Y1 ($\beta = 0.06$, $SE = 0.05$, $p = 0.257$). The effect size was 0.06.
- FRL students within SEED schools and FRL students within non-SEED schools did not differ on ELA outcome by the end of Y3 ($\beta = 0.03$, $SE = 0.05$, $p = 0.535$). The effect size was 0.03.

Goal 5d. Both minority and FRL students within SEED and non-SEED schools maintained the same levels of ELA achievement over time. FRL students within SEED and non-SEED schools also maintained the same level of math achievement over time. Minority students within SEED and non-SEED schools both showed significant levels of decline in math achievement over time. Figures 22 and 23 show the unadjusted mean ELA scores over time between minority students within SEED and non-SEED schools, and FRL students within SEED and non-SEED schools, respectively, over time.

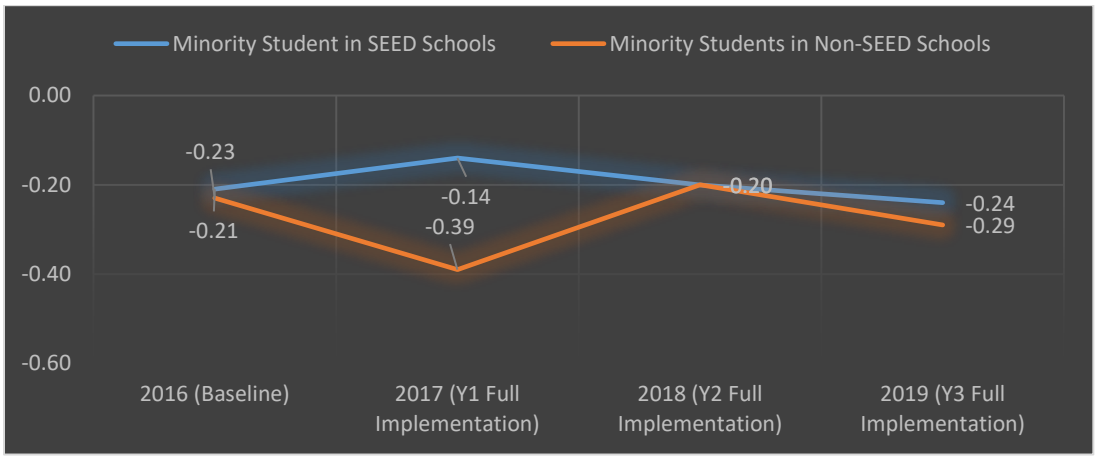


Figure 24. Minority Students in SEED and Non-SEED Schools' Unadjusted Mean ELA Scores Over Time

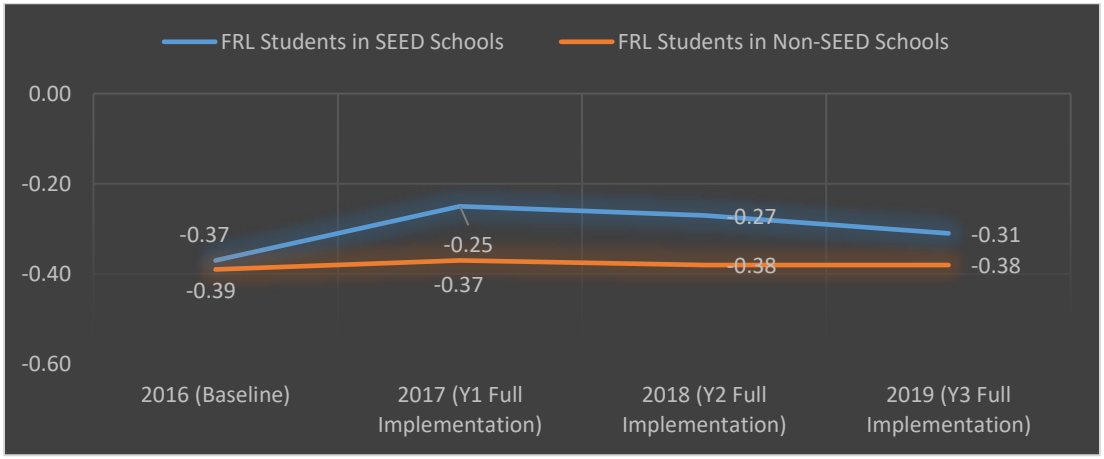


Figure 25. FRL Students in SEED and Non-SEED Schools' Unadjusted Mean ELA Scores Over Time

Figures 24 and 25 show the unadjusted mean math scores over time between minority students within SEED and non-SEED schools, and FRL students within SEED and non-SEED schools, respectively, over time.

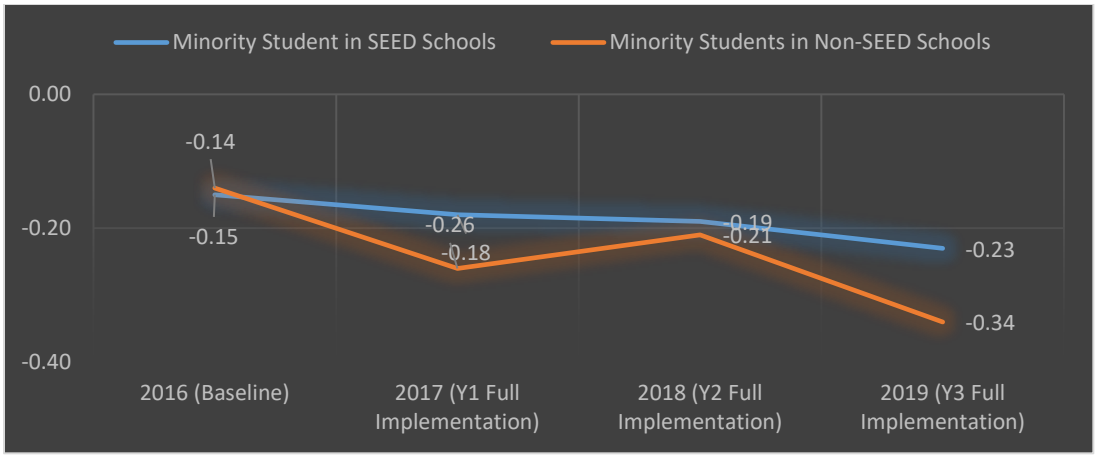


Figure 26. Minority Students in SEED and Non-SEED Schools' Unadjusted Mean Math Scores Over Time

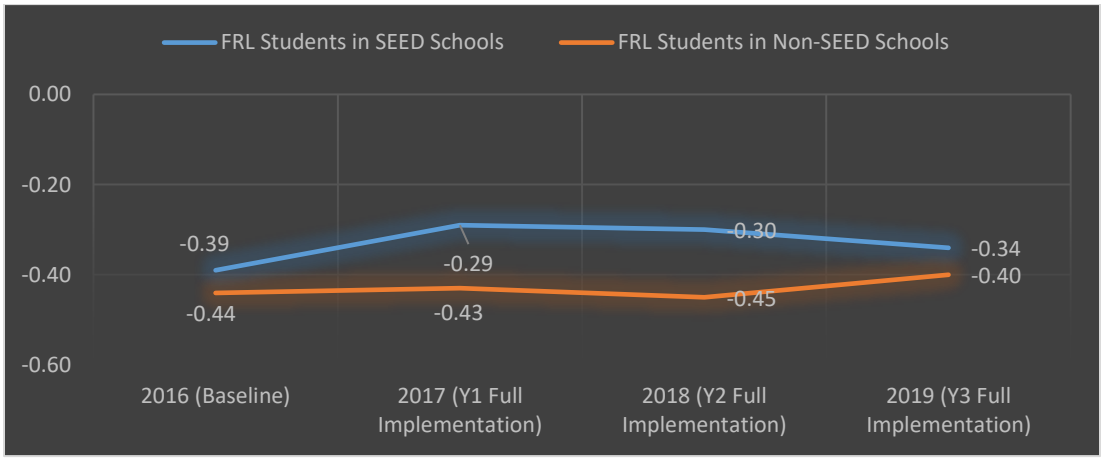


Figure 27. FRL Students in SEED and Non-SEED Schools' Unadjusted Mean Math Scores Over Time

A series of multilevel models was conducted to examine if the rate of change in achievement, if any, differed by groups.[11] Key findings are summarized below:

- Minority students within non-SEED schools did not demonstrate significant change in ELA scores over time (β = -0.00, SE = 0.03, p = 0.911), and the rate of change was not significantly different between minority students within SEED and those within non-SEED schools (β = -0.01, SE = 0.04, p = 0.763). In other words, minority students within both SEED and non-SEED schools, on average, maintained the same level of ELA achievement over time.

[11] All covariates used in the matching were also included in the analyses.

- FRL students within non-SEED schools did not demonstrate significant change in ELA scores over time (β = -0.01, SE = 0.01, p = 0.673), and the rate of change was not different between FRL students within SEED and those within non-SEED schools (β = 0.02, SE = 0.02, p = 0.430). In other words, FRL students within both SEED and non-SEED schools, on average, maintained the same level of ELA achievement over time.
- Minority students within non-SEED schools demonstrated a significant rate of decrease in math outcome over time (β = -0.05, SE = 0.02, p = 0.037), and the rate of change was not significantly different between minority students in SEED schools and those in non-SEED schools (β = 0.02, SE = 0.03, p = 0.492). In other words, minority students in SEED schools and non-SEED schools both demonstrated significant decline in ELA outcomes over time.
- FRL students within non-SEED schools did not demonstrate significant change in math outcome over time (β = 0.00, SE = 0.01, p = 0.793), and the rate of change was not significantly different between FRL students within SEED and those within non-SEED schools (β = 0.02, SE = 0.02, p = 0.431). In other words, FRL students within both SEED and non-SEED schools, on average, maintained the same level of math achievement over time.

Goal 5d. HP and LP schools did not differ on student achievement scores by the end of Y3. Regression analyses were conducted to examine the differences in achievement outcomes, including ELA and math, between HP and LP schools using Y3 data. Results showed that HP and LP schools did not differ on ELA (β = 0.13, SE = 0.09, p = 0.219) or math (β = 0.04, SE = 0.17, p = 0.839) by the end of Y3.

Goal 6. Improve Student Engagement

Goal 6 of SEED was to improve student engagement. Two questions were examined: *Does student engagement increase among participating schools (Goal 6a)? Do schools with higher levels of teacher participation have higher levels of student engagement (Goal 6b)?* Data collected from the student engagement survey between the 2016–17 and the 2018–19 were included in the analyses. To answer Goal 6a, a series of LGC was conducted to examine the rate of change on each of the measured constructs over time. School-level means were used in the analyses. To answer Goal 6b, linear regression analysis was conducted to examine the difference between HP and LP schools on the outcomes of interest. Findings are summarized in the following sections.

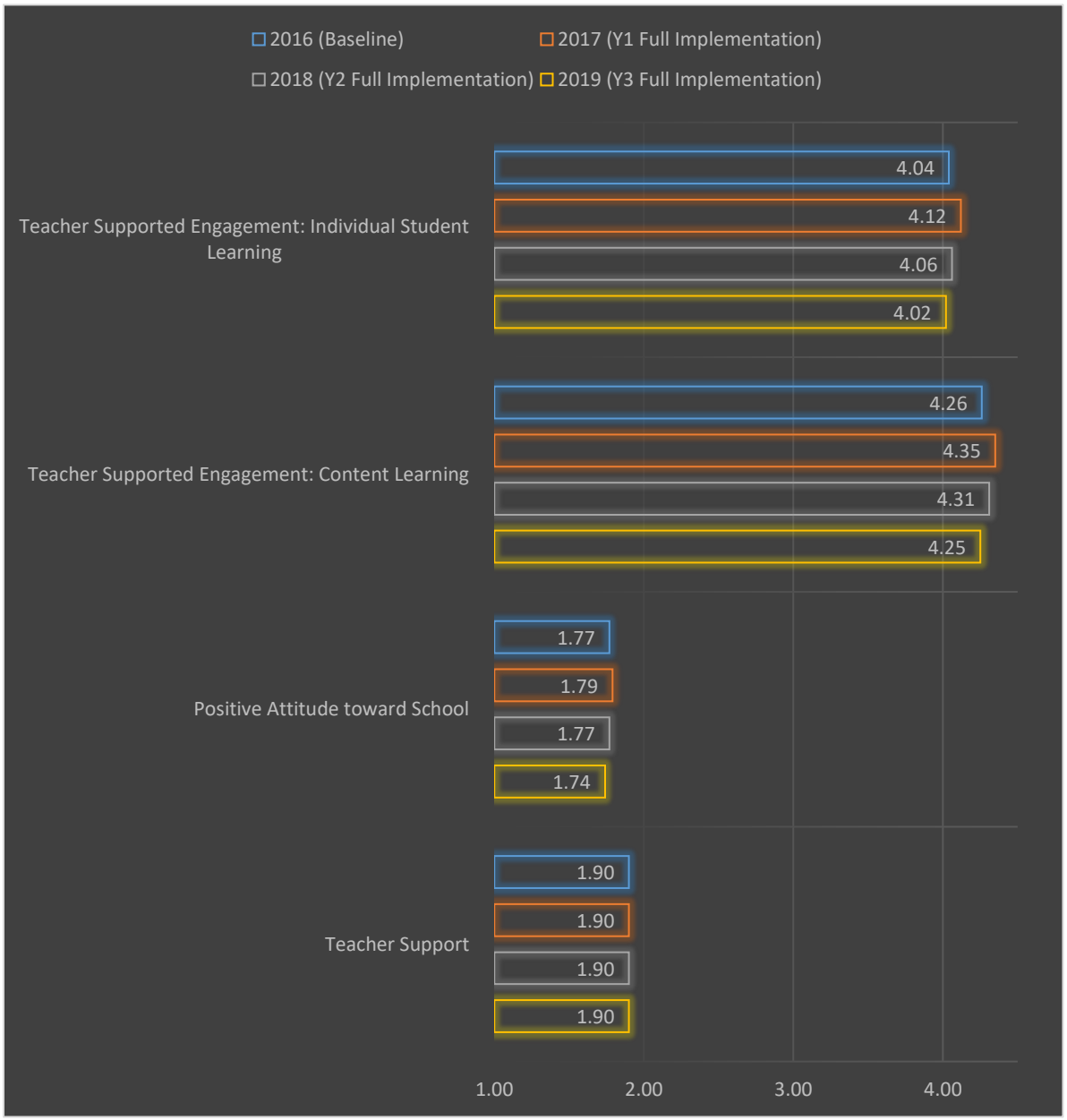
Goal 6a. Levels of student engagement largely remained unchanged over time with some subscales showing decreases over time. Starting with the baseline of full implementation (2016), students in grades 3–5 answered a series of questions related to their sense of school engagement. These questions measured four constructs:

- Teacher-Supported Engagement: Individual Student Learning (4 items)
- Teacher-Supported Engagement: Content Learning (5 items)
- Positive Attitude Toward School (4 items)
- Teacher Support (4 items)

Figure 24 is a visual representation of student engagement ratings across the four constructs over time. Overall, these ratings remained high throughout the implementation period. Results of LGC revealed that, within SEED schools, student ratings on all constructs largely remained unchanged

over time with one exception—student reports of positive attitude toward school decreased significantly over time.

- Teacher-Supported Engagement: Individual Student Learning (β = -0.01, SE = 0.02, p = 0.452)
- Teacher-Supported Engagement: Content Learning (β = -0.01, SE = 0.02, p = 0.572)
- Positive Attitude Toward School (β = -0.02, SE = 0.01, p = 0.019)
- Teacher Support (β = -0.003, SE = 0.01, p = 0.494)



Note: Teacher support and positive attitude toward school were rated Yes (1) or No (0), and the two teacher-supported engagement constructs were rated on a 5-point scale, ranging from strongly disagree (1) to strongly agree (5).

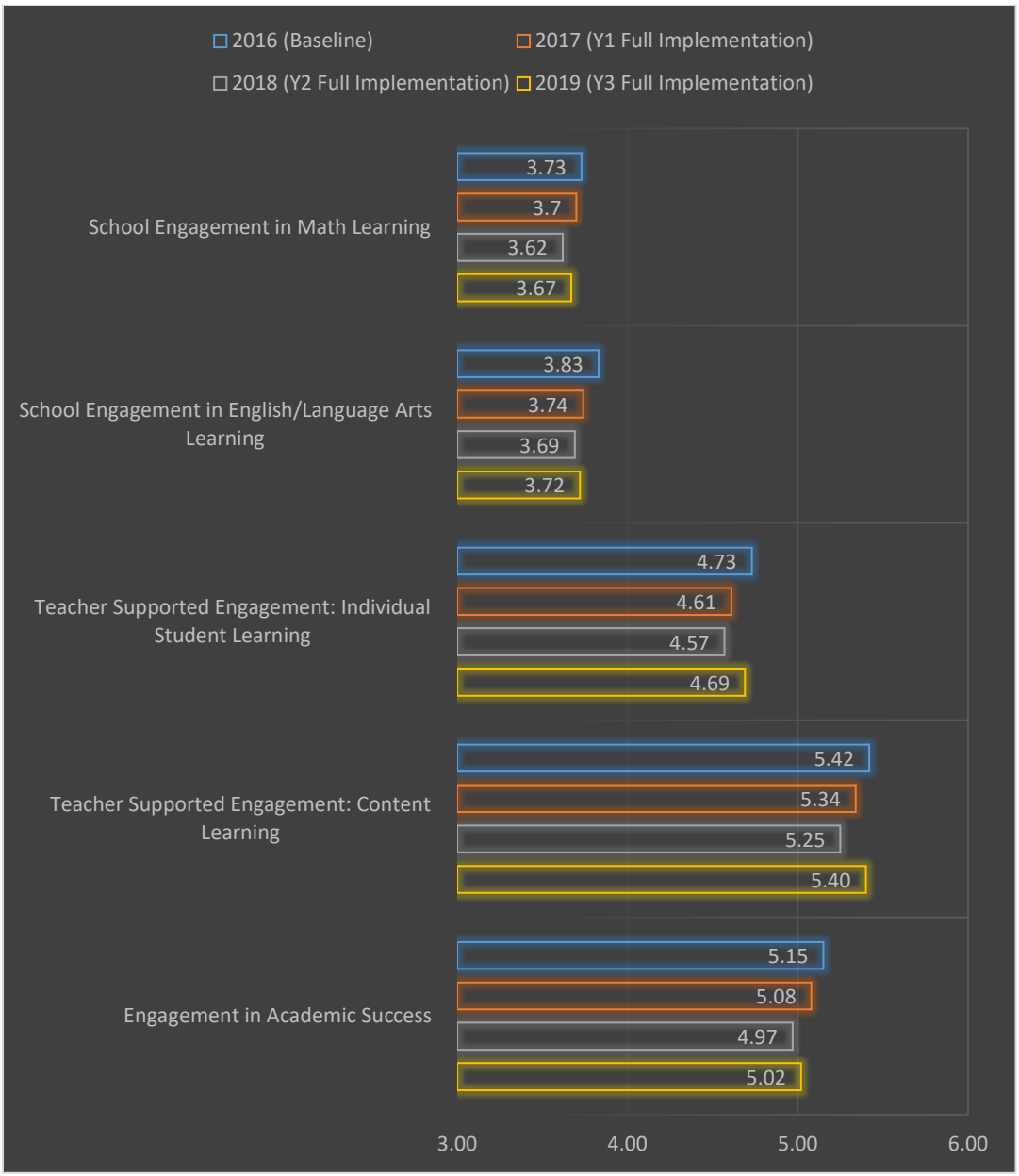
Figure 28. Student Engagement Ratings Over Time: Grades 3–5

Student survey report of student engagement: Grades 6–10. Since the baseline of the full implementation (2016), students in grades 6–10 answered a series of questions related to their sense of school engagement. These questions measured five constructs:

- School Engagement in Math Learning (4 items)
- School Engagement in English/Language Arts Learning (4 items)
- Teacher-Supported Engagement: Individual Student Learning (4 items)
- Teacher-Supported Engagement: Content Learning (5 items)
- Engagement in Academic Success (5 items)

Figure 25 is a visual representation of student engagement ratings across five constructs over time. Results of LGC revealed that, within SEED schools, student ratings on three constructs decreased significantly over time. They were: school engagement in math learning, teacher-supported engagement: individual student learning, and engagement in academic success. The results follow.

- School Engagement in Math Learning (β = -0.08, SE = 0.02, $p < 0.001$)
- School engagement in English/language arts Learning (β =-0.07, SE = 0.03, p = 0.059)
- Teacher-Supported Engagement: Individual Student Learning (β = -0.07, SE = 0.03, p = 0.012)
- Teacher-Supported Engagement: Content Learning (β = -0.04, SE = 0.03, p = 0.203)
- Engagement in Academic Success (β = -0.09, SE = 0.03, p = 0.006)



Notes: School engagement in math leaning and school engagement in English/language arts learning constructs include four items; one is measured on a 6-point scale, and three are measured on a 5-point scale. Teacher-supported engagement constructs were measured on a 5-point scale. Engagement in academic success was measured by four items on a 7-point scale.

Figure 29. Student Engagement Ratings Over Time: Grades 6–10

Goal 6b. HP and LP schools did not differ in terms of levels of student engagement across most of the constructs with one positive exception—HP schools had higher ratings from 6th to 10th graders regarding their perception of teacher-supported engagement: Individual student learning. When comparing the school-level ratings between HP and LP schools, they were similar on most of the student engagement subscales with one exception. That is, students from 6th to 10th grades within HP schools reported a higher level of teacher-supported engagement on individual student learning compared to LP schools. Results from the analyses are summarized as follows.

- Students from grades 3 to 5 (SES: 3rd-5th)
  - Teacher-Supported Engagement: Individual Student Learning (β = 0.25, SE = 0.08, p = 0.096)
  - Teacher-Supported Engagement: Content Learning (β = 0.23, SE = 0.12, p = 0.197)
  - Positive Attitude Toward School (β = 0.12, SE = 0.07, p = 0.251)
  - Teacher Support (β = 0.05, SE = 0.06, p = 0.508)

- Students from grades 6 to 10 (SES: 6th-10th)
  - School Engagement in Math Learning (β = 0.18, SE = 0.21, p = 0.461)
  - School Engagement in English/Language Arts Learning (β =0.14, SE = 0.12, p = 0.302)
  - Teacher-Supported Engagement: Individual Student Learning (β = 0.25, SE = 0.03, p = 0.003)
  - Teacher-Supported Engagement: Content Learning (β =0.26, SE = 0.17, p = 0.213)
  - Engagement in Academic Success (β =0.08, SE = 0.20, p = 0.698)

Conclusions and Recommendations

SEED was designed to achieve six goals. Through one year of planning and pilot testing (2015–16) and four years of full implementation (2016–17 to 2019–20), SEED achieved all six of its goals. Quotes from the teacher participants below highlight the value of SEED.

This is a GREAT way to re-energize and remind yourself of best practices. I found the resources interesting and thought provoking. I implemented elements in my classes each week of the SEED course. I found that the class helped with daily lesson planning for lessons that hopefully ***increased student learning*** and ***engagement***.

This course helped me evolve as a teacher in a world of evolving learners. I feel ***better prepared to teach my students through a collaborative approach and with collaborative strategies***. I have more confidence in my teaching and modeling of collaboration, and I am thrilled at the student outcomes and learning from their collaboration.

The changes that I've made as a result of this course have been instrumental to my ***teaching practice*** and to my ***students' increased learning experiences and understanding***. These changes will continue throughout my teaching career. This course provided me the guidance and the structure to feel safe to take risks and make these changes in my classroom.

I am a total SEED nerd and love these classes! They all build upon one another and help me improve my practice a little more each semester. I am especially excited about how I am pulling in more of my outliers and encouraging and ***inviting more participation from all students***. The coaching sessions are especially helpful to keep me focused and problem solve the classroom implementation between modules. Thank you for providing such positive and relevant professional development for teachers!

I absolutely treasure the pacing of the SEED course. We read insightful resources that cause us to think. We then integrate assignments in the class over the course of a semester. This is so powerful because we are integrating strategies with our real-life kiddos. I feel like every single SEED class I take has ***great impact on my students*** because it gives me a focal point and goal. Additionally, the ***reflection piece is so powerful*** because I take my new tools with me.

The TLC courses are so helpful and ***integrate right into your classroom instruction***. It is easy to learn new things while not feeling overwhelmed by your own planning and the classwork.

The workload required for the TLC courses is manageable while teaching during the school year. The changes that I've made while taking this course have ***been invaluable to my students' understanding and to my teaching practice***. I was able to implement changes that I've been thinking about making for a while but needed the support and guidance. The TLC provided me with that through reading resources, peer support, and coaching conversations.

I loved this course. [ICs] are always super supportive and provide great insight and direction for how to push my thinking. I love the ***classroom implementation component of the TLC*** and all the SEED courses so that I am pushed to take what I learn and put it into practice. I can't wait to be back in my classroom guiding my class and myself to be better learners.

My TLC experience was meaningful and fit into my schedule as a teacher. It was wonderful because it ***directly relates and can be incorporated into your current classroom***. It is a great use of time for getting more PD.

I would say that it is valuable. You learn authentic educational material, and you can immediately implement what you have learned in the classroom. Also, the way it is ***tied to the state evaluation rubric*** is very helpful when designing your individual goals for the year. I would definitely recommend the course.

—SEED participants

Implementation data also showed that SEED was successfully implemented and continually improved in 21 schools throughout the project period. Seven out of eight fidelity indicators (88%) achieved the desired level of implementation. Additionally, SEED significantly increased the short-term outcomes as depicted in the logic model (see Figure ES1), and ultimately has provided some positive and promising pieces of evidence supporting its desired long-term outcome—student achievement. Specifically, SEED significantly increased student achievement among minority learners after one year of implementation. Additionally, SEED had some marginal effects across various groups and outcomes, including all students' ELA outcome in Y3; FRL students' ELA and math outcomes in Y2; and minority students' math outcome in Y1. When examining the trajectories of student achievement between SEED and non-SEED schools, results showed that while non-SEED schools showed a statistically significant decline on ELA scores over time, SEED schools maintained the same level of ELA scores over time.

Considering these effects within the context that the desired level of teacher participation was not achieved until Y3, the observed effects were encouraging. According to SEED participation data, the school-level SEED participation rate (percentage of teachers participating in SEED) was 16% (ranging from 0% to 63%), 20% (ranging from 6% to 48%), 33% (ranging from 7% to 69%), and 40% (ranging from 10% to 100%) in Y1, Y2, Y3, and Y4, respectively. Figure 26 shows the school-level participation rate over time; participation levels within schools fluctuated over time, and there were noticeable variations in terms of participation rates across schools. One may imagine the potential impact of SEED if the participation level was higher and more consistent throughout the participating schools.

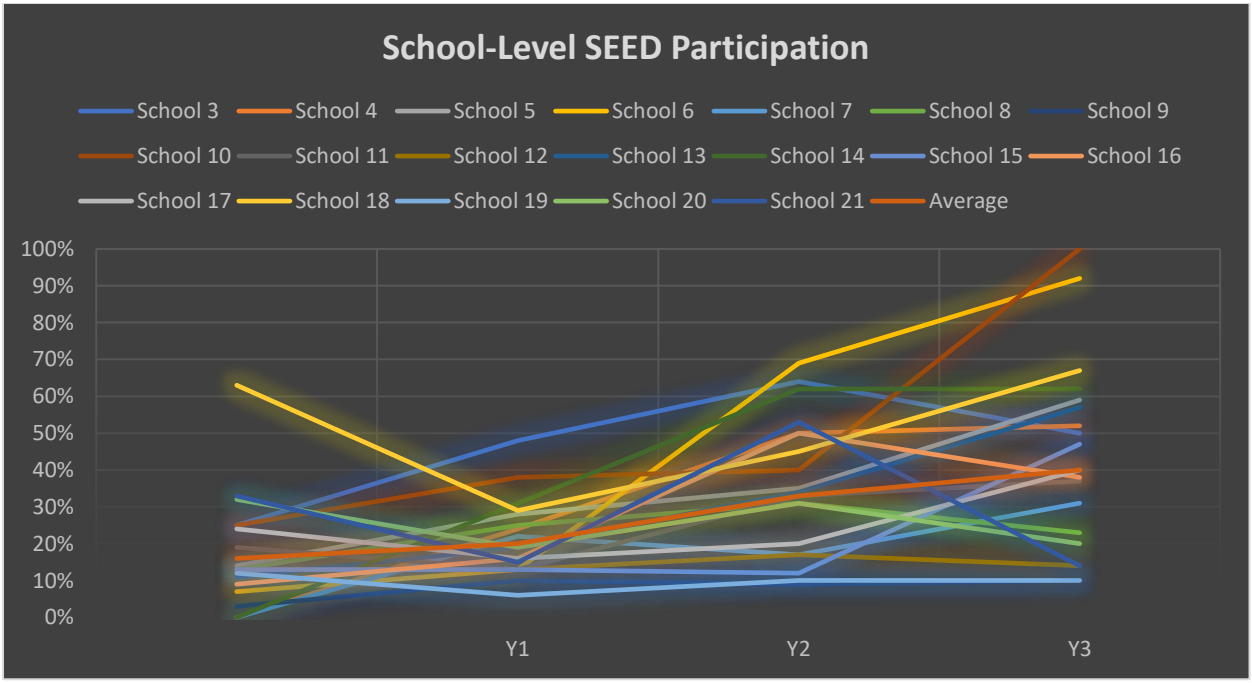


Figure 30. School-Level SEED Participation Over Time

This evaluation provided some positive and promising pieces of evidence to support SEED's theory of action. In Figure 27, the solid blue arrows illustrate pathways that were supported by the evaluation. More research is needed to establish the links between the short-term (Goals 2–4 and 6) and long-term outcomes (Goal 5). The pathways illustrated by orange dashed arrows were not tested in this evaluation. Future studies examining the mediation pathways presented in Figure 31 will

provide valuable information regarding the understanding of the mechanisms through which programs like SEED work to support student achievement.

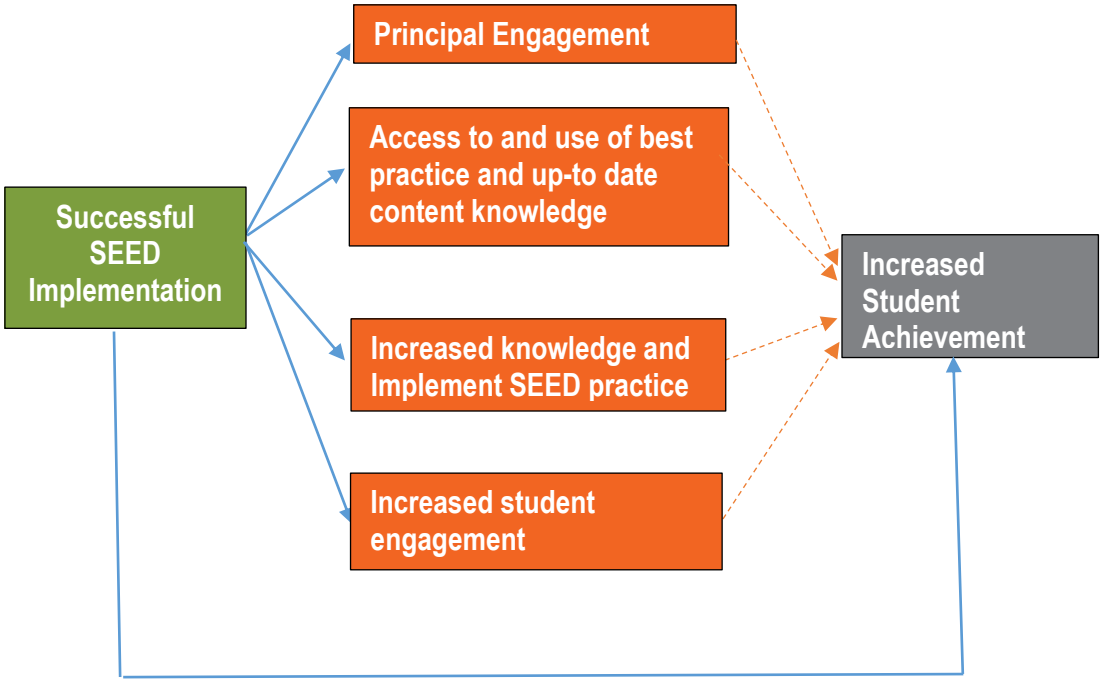


Figure 31. The Pathways Through Which SEED Exerts Its Influence on Student Achievement

References

Berger, H., Eylon, B.-S., & Bagno, E. (2008). Professional development of physics teachers in an evidence-based blended learning program. *Journal of Science Education and Technology, 17*(4), 399–409. http://dx.doi.org/10.1007/s10956-008-9109-3

Bug, L. (2018). *K–8 teacher blended learning professional development, NGSS, and communities of practice: A mixed methods study* (Publication No. 10903629) [Doctoral dissertation, The Pennsylvania State University]. ProQuest Dissertations Publishing.

Catalano, R. F., Park, J., Harachi, T. W., Haggerty, K. P., Abbott, R. D., & Hawkins, J. D. (2005). Mediating the effects of poverty, gender, individual characteristics, and external constrants on antisocial behavior: A test of the social development model and implications for developmental life-course theory. In D. P. Farrington (Ed.), *Advances in criminological theory integrated developmental and life-course theories of offending* (Vol. 14, pp. 93–123). Transaction Publishers.

Christensen, C. M., Horn, M. B., & Staker, H. (2013, May). *Is K–12 blended learning disruptive? An introduction to the theory of hybrids*. Clayton Christensen Institute for Disruptive Innovation. https://files.eric.ed.gov/fulltext/ED566878.pdf

Comrey, A., & Lee, H. (1992). *A first course in factor analysis*. Lawrence Erlbaum Associates.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017, June 5). *Effective teacher professional development*. Learning Policy Institute. https://learningpolicyinstitute.org/product/effective-teacher-professional-development-report

Darling-Hammond, L., & McLaughlin, M. W. (2011). Policies that support professional development in an era of reform. *Phi Delta Kappan, 92*(6), 81–92. 10.1177/003172171109200622

Dornbusch, S., & Steinberg, L. (1990). *Measures of school engagement*. Temple University, Department of Psychology.

Evans, L. (2014). Leadership for professional development and learning: Enhancing our understanding of how teachers develop. *Cambridge Journal of Education, 44*(2), 179–198. 10.1080/0305764X.2013.860083

Gaumer Erickson, A. S., Noonan, P. M., & McCall, Z. (2012). Effectiveness of online professional development for rural special educators. *Rural Special Education Quarterly, 31*(1), 22–32. http://dx.doi.org/10.1177/875687051203100104

Glomb, N., Midenhall, T., Mason, L. L., & Salzberg, C. (2009). Reducing isolation through regional mentors and learning communities: A way to support rural learners. *Rural Special Education Quarterly, 28*(4), 31–35.

Guskey, T. R. (2002). Professional development and teacher change. *Teachers & Teaching, 8*(3/4), 381–391. https://doi.org/10.1080/135406002100000512

Hallinger, P., Liu, S., & Piyaman, P. (2019). Does principal leadership make a difference in teacher professional learning? A comparative study China and Thailand. *Compare: A Journal of Comparative and International Education, 49*(3), 341–357. http://dx.doi.org/10.1080/03057925.2017.1407237

Hawkins, J. D., & Catalano, R. F. (1990). *Seattle Social Development Project*. University of Washington.

Herrington, A., Herrington, J., Kervin, L., & Ferry, B. (2006). The design of an online community of practice for beginning teachers. *Contemporary Issues in Technology & Teacher Education, 6*(1), 120–132.

http://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=20793846&site=ehost-live

Hilliard, A. T. (2015). Global blended learning practices for teaching and learning, leadership, and professional development. *Journal of International Education Research, 11*(3), 179–188.

Howley, A., & Howley, C. B. (2005). High-quality teaching: Providing for rural teachers' professional development. *Rural Educator, 26*, 1–5.

Jaquith, A., Mindich, D., Wei, R. C., & Darling-Hammond, L. (2011). Teacher professional learning in the U.S.: Case studies of state policies and strategies. *Education Digest: Essential Readings Condensed for Quick Review, 77*(2), 33–39. http://www.eddigest.com/index.php

Knapczyk, D., Chapman, C., Rodes, P., & Chung, H. (2001). Teacher preparation in rural communities through distance education. *Teacher Education and Special Education, 24*(4), 402–407.

Koonce, M., Pijanowski, J. C., Bengtson, E., & Lasater, K. (2019). Principal engagement in the professional development process. *NASSP Bulletin, 103*(3), 229–252. https://doi.org/10.1177%2F0192636519871614

Kusche, C. A., & Greenberg, M. T. (1988). *Seattle Personality Questionnaire for Young School Aged Children*. University of Washington, Department of Psychology.

Landau, M. J., Oyserman, D., Keefer, L. A., & Smith, G. C. (2014). The college journey and academic engagement: How metaphor use enhances identity-based motivation. *Journal of Personality and Social Psychology, 106*, 679–698.

Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009, May). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. *US Department of Education*, *93*.

Mishkind, A. (2014). *Evidence-based professional learning* (Research Brief No. 11). California Department of Education. https://www.calpro-online.org/pubs/evidencebasedprofessionallearning.pdf

New Teacher Center. (2014). *2014 North Carolina teacher working conditions survey* (Research Brief).

Peltola, P., Haynes, E., Clymer, L., McMillan, A., Williams, H., & Haidee, W. (2017). *Opportunities for teacher professional development in Oklahoma rural and nonrural schools. REL 2017–273*. U.S. Department of Education Institute of Education Sciences National Center for Education Evaluation and Regional Assistance, & Regional Educational Laboratory Southwest as SEDL. https://eric.ed.gov/?id=ED575846

Philipsen, B. (2019). A professional development process model for online and blended learning: Introducing digital capital. *Contemporary Issues in Technology and Teacher Education, 19*(4), 850–867. https://citejournal.org/wp-content/uploads/2019/10/v19i4Currentpractice1.pdf

Robinson, V. M. J., Lloyd, C. A., & Rowe, K. J. (2008). The impact of leadership on student outcomes: An analysis of the differential effects of leadership types. *Educational Administration Quarterly, 44*(5), 635–674. http://dx.doi.org/10.1177/0013161X08321509

Rubin, D. B. (2001). Using propensity scores to help design observational studies: Application to the tobacco litigation. *Health Services & Outcomes Research Methodology, 2*, 169–188.

Sinclair, M., & Owston, R. (2006). Teacher Professional Development in Mathematics and Science: A Blended Learning Approach. *Canadian Journal of University Continuing Education, 32*(2), 43–66.

Vescio, V., Ross, D., & Adams, A. (2008). A Review of research on the impact of professional learning communities on teaching practice and student learning. *Teaching and Teacher Education: An International Journal of Research and Studies, 24*(1), 80–91. http://dx.doi.org/10.1016/j.tate.2007.01.004

What Works Clearinghouse. (2017). *What Works Clearinghouse: Procedures and Standards Handbook, Version 4.0*.

Whitworth, B., & Chiu, J. (2015). Professional Development and Teacher Change: The Missing Leadership Link. *Journal of Science Teacher Education, 26*(2), 121–137. https://doi.org/10.1007/s10972-014-9411-2

Yates, S. M., & Harris, J. H. (2003). *Teacher perceptions of professional learning*. Flinders University.

Yoon, K. S., Garet, M., Birman, B., & Jacobson, R. (2006). *Examining the effects of mathematics and science professional development on teachers' instructional practice: Using professional development activity log*. Council of Chief State School Officers. http://www.pdal.net/inc/docs/AIR%20MSP_Finalreport.pdf

Zilinskiene, I., Malinauskiene, E., & Smith, R. (2016). Effectiveness and Efficiency of Blended Learning Model for Developing Leadership Skills. *Proceedings of the European Conference on e-Learning*, 718–726.

Appendices

Appendix A. SEED Evaluation: Technical Report

The System for Educator Effectiveness (SEED) was a six-year project (2015–2020) funded by the U.S. Department of Education, Office of Improvement and Innovation, Investing in Innovation (i3) program. SEED was led by the Northwest Colorado Board of Cooperative Educational Services (NW BOCES). McREL International (McREL) was the third-party evaluation partner for the project. Figure A1 shows an overview of the SEED project phases, implementation components, and the overarching goals.

SEED Phases	• Phase I (spring 2015): Program development • Phase II (2015–16 school year): Pilot testing and baseline data collection • Phase III (2016–17 to 2019–20 school years): Full implementation
Components	• Create evidence-based PD driven by teacher needs and interests • Deliver PD through a dynamic PD platform that enables online PD and blended learning TLC • Develop a repository of online, up-to-date, evidence-based PD resources aligned with Educator Effectiveness standards • Engage principals and teachers in teacher PD
SEED Goals	• Goal 1: Successfully implement and continually improve the SEED project in up to 30 NW BOCES schools during a four-year period • Goal 2: Improve principal engagement in teacher professional growth and support • Goal 3: Increase rural teachers' access to and use of current best practices and up-to-date content knowledge • Goal 4: Support teachers in successfully implementing SEED practices and content • Goal 5: Improve student achievement • Goal 6: Improve student engagement

Figure A1. SEED Project Phase, Components, and Goals

Figure A2 shows the links between SEED components (strategies), outputs, short-term outcomes, and long-term outcomes that are aligned with the six specified project goals. SEED strategies presented in the logic model were guided by the research on evidence-based PD for rural educators (Darling-Hammond et al., 2017; Gaumer Erickson et al., 2012; Howley & Howley, 2005; Koonce et al., 2019; Vescio et al., 2008). It was hypothesized that, if all elements of SEED were implemented as planned (i.e., high fidelity; Goal 1), SEED would increase principal and teacher engagement in teacher PD (Goal 2); increase teacher access to evidence-based PD (Goal 3); and increase teacher implementation of knowledge and skills learned from PD in the classroom (Goal 4). These changes in classroom practice would result in improved student engagement (Goal 5) and then student achievement (Goal 6).

SEED Strategies	Outputs	Short-term Outcomes	Long-term Outcomes
SEED Creation • Create evidence-based PD driven by teacher needs and interests • Develop a repository of online, up-to-date, evidence-based PD resources aligned with Educator Effectiveness standards **SEED Delivery** • Deliver PD through a dynamic PD platform that enables online PD and blended learning TLC **SEED Participation** • Engage principals and teachers in teacher PD	• SEED strategies were implemented as planned in all SEED schools (Goal 1)	• Increased principal and teacher engagement in teacher PD (Goal 2) • Increased teacher access to evidence-based PD (Goal 3) • Increased teacher application of knowledge and skills learned from PD in classroom (Goal 4) • Improved student engagement (Goal 6)	• Improved student achievement (Goal 5)

Figure A2. SEED Logic Model

The purpose of this appendix is to provide detailed information regarding the evaluation plan, including evaluation questions, evaluation design, study sample, data collection methods, and data analysis plan. Each element is discussed in detail in the following sections.

Evaluation Questions

Evaluation questions were guided by the SEED logic model and were designed to address each of the specified project goals. Table A1 shows the alignment of the evaluation questions, evaluation designs, and data collection methods by project goal. Abbreviations used in Table A1 are defined as follows.

Evaluation Design	
P = Process evaluation	
O = Outcome evaluation	
QED = Quasi-experimental design	
C = Correlational study	
Data Collection Methods	
PR = Project records	TI = Teacher interview
ICI = Innovation Coaches (IC) interview	TS = Teacher survey
PI = Principal interview	SES = Student engagement survey
PS = Principal survey	ED = Extant data from the CDE

Questions specified under Goal 1 were designed to understand the extent to which the elements of SEED were implemented as intended with planned rigor; what the challenges and successes were; and what revisions or modifications were made during the implementation period and for what reasons. Questions specified under Goals 2, 3, 4, and 6 aimed to understand how and the extent to which the project improved the short-term outcomes as specified in the logic model, including (1) improved principal engagement in teacher professional growth and support (Goal 2); (2) increased rural teachers' access to and use of current best practices and up-to-date content knowledge (Goal 3); (3) increased implementation of SEED practices and content (Goal 4); and (4) increased student engagement (Goal 6). Questions for Goal 5 were designed to understand the extent to which the project achieved the long-term outcome of improved student achievement, SEED's ultimate goal.

Table A1. Evaluation Questions, Evaluation Design, and Data Collection Methods by Project Goals

Evaluation Questions	Evaluation Design			Data Collection Methods
	P	O		
		C	QED	
Goal 1. Successfully implement and continually improve SEED in up to 30 NW BOCES schools during a four-year period (timeliness and continuous improvement)				
a. Are project activities occurring as planned?	X			PR, ICI, PI, PS, TI, TS, TS
b. Is the project maintaining its planned rigor?	X			
c. What barriers and unanticipated outcomes were encountered, and what revisions were made during implementation?	X			
d. What were key project successes during implementation?	X			
Goal 2. Improve principal engagement in teacher professional growth and support				
a. Are principals more engaged in teacher professional growth?		X		PI, PS, TI, TS
b. Are principals able to provide more and better support to teachers through SEED?		X		
c. Do SEED teachers, in comparison with non-SEED teachers, report a higher level of principal engagement in teacher professional growth?*		X		TS
d. What is the relationship between school-level SEED participation rates and principal and teacher reports of principal engagement in teacher PD?*		X		PS, TS
Goal 3. Increase rural teachers' access to and use of current best practices and up-to-date content knowledge				
a. Are teachers utilizing SEED? Which activities are teachers using? Does use increase over time?	X			PR, TS
b. Is PD reflective of best practices and up-to-date content knowledge?		X		PI, PS, TI, TS
c. Do teachers have time and resources to access PD?		X		
d. Is PD offered to teachers driven by data and does it meet the needs of individual teachers?		X		
e. Do SEED teachers, in comparison with non-SEED teachers, give higher ratings regarding the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is data-driven and aligned with individual needs; and (3) teachers have time and resources to access PD?*		X		PS, TS
f. What is the relationship between school-level SEED participation rates and teachers' ratings on the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is data-driven and		X		PS, TS

Evaluation Questions	Evaluation Design			Data Collection Methods
	P	O		
		C	QED	
aligned with individual needs; and (3) teachers have time and resources to access PD?*				
Goal 4. Support teachers in successfully implementing SEED practices and content				
a. Does teachers' knowledge of best practices increase?		X		TS
b. Do teachers demonstrate practice change in the classroom?		X		TI, TS, ED
c. Do SEED teachers, in comparison with non-SEED teachers, (1) give higher ratings on their knowledge of best practices, (2) have more opportunity to collaborate with job-alike peers, and (3) have higher teacher evaluation scores?*		X		TS, ED
d. What is the relationship between school-level SEED participation rates and (1) teachers' ratings on their knowledge of best practices, (2) teachers' opportunity to collaborate with job-alike peers, and (3) teacher evaluation scores?*		X		TS, ED
Goal 5. Improve student achievement				
a. To what extent do SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation?			X	ED
b. To what extent do students from SEED schools demonstrate an increase in student achievement outcomes over time?*			X	ED
c. To what extent do high-needs students from SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation?			X	ED
d. To what extent do high-needs students from SEED schools demonstrate an increase in student achievement outcomes over time?*			X	ED
e. Do schools with higher levels of teacher participation have higher overall student achievement?*		X		PR, TS, ED
Goal 6. Improve student engagement				
a. Does student engagement increase among participating schools?		X		SES
b. Do schools with higher levels of teacher participation have higher levels of student engagement?*		X		PR, TS, SES

Note. In 2017–18 (grant Year 3), the data collection plan was strategically revised to reduce the redundancy of information collected over time. Specifically, principal, teacher and IC interviews were removed from the evaluation data collection plan. The teacher survey was revised to include questions related to teacher perceptions of principal engagement in teacher PD that were originally collected through teacher interview. In this table, additional questions added in the 2017–18 reporting period are marked with an asterisk.

Evaluation Design

The SEED evaluation included both a ***process*** evaluation and an ***outcome*** evaluation to address the proposed evaluation questions. Each approach is discussed in the following sections.

Process Evaluation Design

The process evaluation focused on documenting and describing the services, activities, and procedures of SEED to have a better understanding about the implementation fidelity and challenges encountered (Questions 1a, 1b, 1c and 1d), as well as teacher utilization of SEED

(questions 3d and 3e). Additionally, as a part of the process evaluation, data on the project's progress in achieving short-term outcomes on an annual basis were examined and provided to the project team to inform decisions regarding program improvement and refinement, as needed, to ensure the project goals were achieved. As shown in Table A1, various data sources were analyzed and triangulated to provide an in-depth and comprehensive understanding of program implementation. Additionally, an implementation fidelity matrix was created to understand and monitor the extent to which SEED strategies were implemented as planned and with the intended rigor. The fidelity matrix is presented in the Data Collection Methods section under Fidelity Assessment.

Outcome Evaluation Design

The outcome evaluation was conducted to understand the extent to which SEED had a positive effect on principal engagement in teacher PD (Goal 2), teacher access to and use of best practices and up-to-date content knowledge (Goal 3), teacher implementation of SEED practice and content in the classroom (Goal 4), student achievement (Goal 5), and student engagement (Goal 6). As shown in Table A2, different study designs were employed to address different sets of questions.

Table A2. Evaluation Questions and Research Design by Project Goal

Evaluation Questions	Research Design
Goal 1. Successfully implement and continually improve SEED in up to 30 NW BOCES schools during a four-year period (timeliness and continuous improvement)	
a. Are project activities occurring as planned?	Process evaluation
b. Is the project maintaining its planned rigor?	
c. What barriers and unanticipated outcomes were encountered, and what revisions were made during implementation?	
d. What were key project successes during implementation?	
Goal 2. Improve principal engagement in teacher professional growth and support	
a. Are principals more engaged in teacher professional growth?	Correlational design—single group with repeated measures
b. Are principals able to provide more and better support to teachers through SEED?	
c. Do SEED teachers, in comparison with non-SEED teachers, report a higher level of principal engagement in teacher professional growth?*	Correlational design—SEED and non-SEED teacher comparisons
d. What is the relationship between school-level SEED participation rates and principal and teacher reports of principal engagement in teacher PD?*	Correlational design—low- and high-participation school comparisons
Goal 3. Increase rural teachers' access to and use of current best practices and up-to-date content knowledge	
a. Are teachers utilizing SEED? Which activities are teachers using? Does use increase over time?	Process evaluation
b. Is PD reflective of best practices and up-to-date content knowledge?	Correlational design—single group with repeated measures
c. Do teachers have time and resources to access PD?	
d. Is PD offered to teachers driven by data and does it meet the needs of individual teachers?	
e. Do SEED teachers, in comparison with non-SEED teachers, give higher ratings regarding the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is	Correlational design—SEED and non-SEED teacher comparisons

Evaluation Questions	Research Design
data-driven and aligned with individual needs; and (3) teachers have time and resources to access PD?*	
f. What is the relationship between school-level SEED participation rates and teachers' ratings on the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is data-driven and aligned with individual needs; and (3) teachers have time and resources to access PD?*	Correlational design—low- and high-participation school comparisons
Goal 4. Support teachers in successfully implementing SEED practices and content	
a. Do teachers' knowledge of best practices increase?	Correlational design—single group with repeated measures
b. Do teachers demonstrate practice change in the classroom?	
c. Do SEED teachers, in comparison with non-SEED teachers, (1) give higher ratings on their knowledge of best practices, (2) have more opportunity to collaborate with job-alike peers, and (3) have higher teacher evaluation scores?*	Correlational design—SEED and non-SEED teacher comparisons
d. What is the relationship between school-level SEED participation rates and (1) teachers' ratings on their knowledge of best practices, (2) teachers' opportunity to collaborate with job-alike peers, and (3) teacher evaluation scores?*	Correlational design—low- and high-participation school comparisons
Goal 5. Improve student achievement	
a. To what extent do SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation?	QED with a matched comparison group
b. To what extent do students from SEED schools demonstrate an increase in student achievement outcomes over time?*	
c. To what extent do high-needs students from SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation?	
d. To what extent do high-needs students from SEED schools demonstrate an increase in student achievement outcomes over time?*	
e. Do schools with higher levels of teacher participation have higher overall student achievement?*	Correlational design—low- and high-participation school comparisons
Goal 6. Improve student engagement	
a. Does student engagement increase among participating schools?	Correlational design—single group with repeated measures
b. Do schools with higher levels of teacher participation have higher levels of student engagement?*	Correlational design—low- and high-participation school comparisons

Note. In 2017–18 (grant Year 3), the data collection plan was strategically revised to reduce the redundancy of information collected over time. Specifically, principal, teacher and IC interviews were removed from the evaluation data collection plan. The teacher survey was revised to include questions related to teacher perceptions of principal engagement in teacher PD that were originally collected through teacher interview. In this table, additional questions added in the 2017–18 reporting period are marked with an asterisk.

Each research design is discussed as follows.

Correlational design—single group with repeated measures. SEED was a school-level intervention. SEED services were available to all teachers in SEED schools; therefore, it was hypothesized that all teachers and students within schools might have benefited from SEED in a wide variety of ways, from principal engagement, to SEED course offerings, to SEED PAK

resources. Therefore, principal, teacher, and student-level data were aggregated to the school level and used in the analysis to understand the extent to which the outcomes of interest reported by principals, teachers, and students changed over time. Questions for Goals 2a, 2b, 3b, 3c, 3d, 4a, 4b, and 6a were addressed using this design with all relevant data collected throughout the project period.

Correlational design—SEED and non-SEED teacher comparisons (non-matched). This design was employed to understand the differences in outcomes of interest between SEED and non-SEED teachers[12] utilizing teacher participation data and teacher survey data collected during the 2018–19[13] school year (Y3 full implementation). Questions for Goals 2c, 3e and 4c were addressed using this design.

Correlational design—low and high participation schools. This design was employed to understand the associations between level of SEED participation at the school level (e.g., low vs. high) and the outcomes of interest. Level of SEED participation was measured by the percentage of teachers who were defined as SEED participants within each school (see the above "correlational design—SEED and non-SEED teacher comparison" section for the definition of SEED participation). Data collected from 2018–19 (Y3 full implementation) were used for the analysis. Questions for Goals 2d, 3f, 4d, 5e, 5f, and 6b were addressed using this design.

Quasi-experimental design (QED) with a matched comparison group. A quasi-experimental design using propensity score matching methods (PSM) was employed to understand the impact of SEED on student achievement (Goals 5a and 5c) and growth (Goals 5b and 5d) over time. The primary impact question was: *To what extent do SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation* (Goal 5a)? To address this question, six sub-questions were examined:

5a1. To what extent do SEED schools and comparison schools differ in reading outcomes after one year of full implementation?

5a2. To what extent do SEED schools and comparison schools differ in reading outcomes after two years of full implementation?

5a3. To what extent do SEED schools and comparison schools differ in reading outcomes after three years of full implementation?

5a4. To what extent do SEED schools and comparison schools differ in math outcomes after one year of full implementation?

5a5. To what extent do SEED schools and comparison schools differ in math outcomes after two years of full implementation?

5a6. To what extent do SEED schools and comparison schools differ in math outcomes after three years of full implementation?

In addition to understanding the impact of SEED on all students within SEED schools, the impact on subgroups of students within SEED was also of interest:*To what extent do high-needs students from*

[12] The distinction between SEED and non-SEED teachers is described in the Study Samples section.

[13] Due to interruption of data collection by the COVID-19 pandemic, the survey response rates from teachers, principals and students during the 2019–20 school year were much lower than the response rates from these groups prior to 2019–20. Additionally, the state department of education waived the state standardized assessments during the 2019–20 school year. As a result, data collected during the 2018–19 school year had the most complete data to answer the proposed evaluation questions.

SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation (Goal 5c)? The subgroups included (1) students from racial/ethnic minority groups[14] (MINORITY) and (2) students receiving free or reduced-price lunch (FRL). The same set of six sub-questions described above were also examined for each subgroup as exploratory questions. In addition to understand the impact on the outcomes at the end of each year, questions related to growth were also examined: *To what extent do students form SEED schools demonstrate a statistically significant increase in student achievement outcomes over time (Goal 5b)? To what extent do high-needs students from SEED schools demonstrate a statistically significant increase in student achievement outcomes over time (Goal 5c)?*

In sum, a QED study with six different analytic samples was conducted to address the proposed impact questions across student groups (i.e., all students and two different subgroups) and subject areas (i.e., ELA and math). They are:

Sample 1: All students with ELA outcome

Sample 2: Minority students with ELA outcome

Sample 3: FRL students with ELA outcome

Sample 4: All students with Math outcome

Sample 5: Minority students with Math outcome

Sample 6: FRL students with Math outcome

For each QED study sample, PSM was employed to identify a group of matched comparisons. The list of covariates in the matching process included baseline data collected during the 2015–16 school year (baseline year before full implementation). The covariates include school size, building type, locale, percentage of minority students, percentage of students receiving free or reduced lunch, percentage of English learners, and school-level student achievement. More information about the PSM methods and procedures are described in the Study Samples section.

Study Samples

This section discusses the study samples and characteristics of the samples across all evaluation questions.

SEED Schools

A total of 21 K–12 traditional public schools across seven school districts voluntarily participated in the SEED implementation. The 21 participating schools included: (1) nine elementary schools; (2) three middle schools; (3) three high schools; (4) two elementary and middle schools; (5) three middle and high schools; and (6) one K–12 school. In the 2018–19 school year, one elementary school was closed, and most of the students from the school were enrolled in the other two SEED schools within the district. Three schools (14%) are in the remote areas, and 18 schools (86%) are in the outlying towns or cities where access to high quality PD is often a challenge for educators. Fifteen (71%) schools have student enrollment less than 400 (i.e., small schools), and six (29%) schools have student enrollment equal or greater than 400. The average percentage of minority students across SEED schools was 21%, ranging from 6 to 41% in 2016. The average percentage of FRL students

[14] Racial and ethnic minority was defined as a student with a non-white race/ethnicity.

was 38%, ranging from 17 to 61%. The average percentage of EL students was 12%, ranging from 4 to 26%. Figure A2 shows the distribution of school demographic characteristics and baseline achievement data[15] across 21 SEED schools.

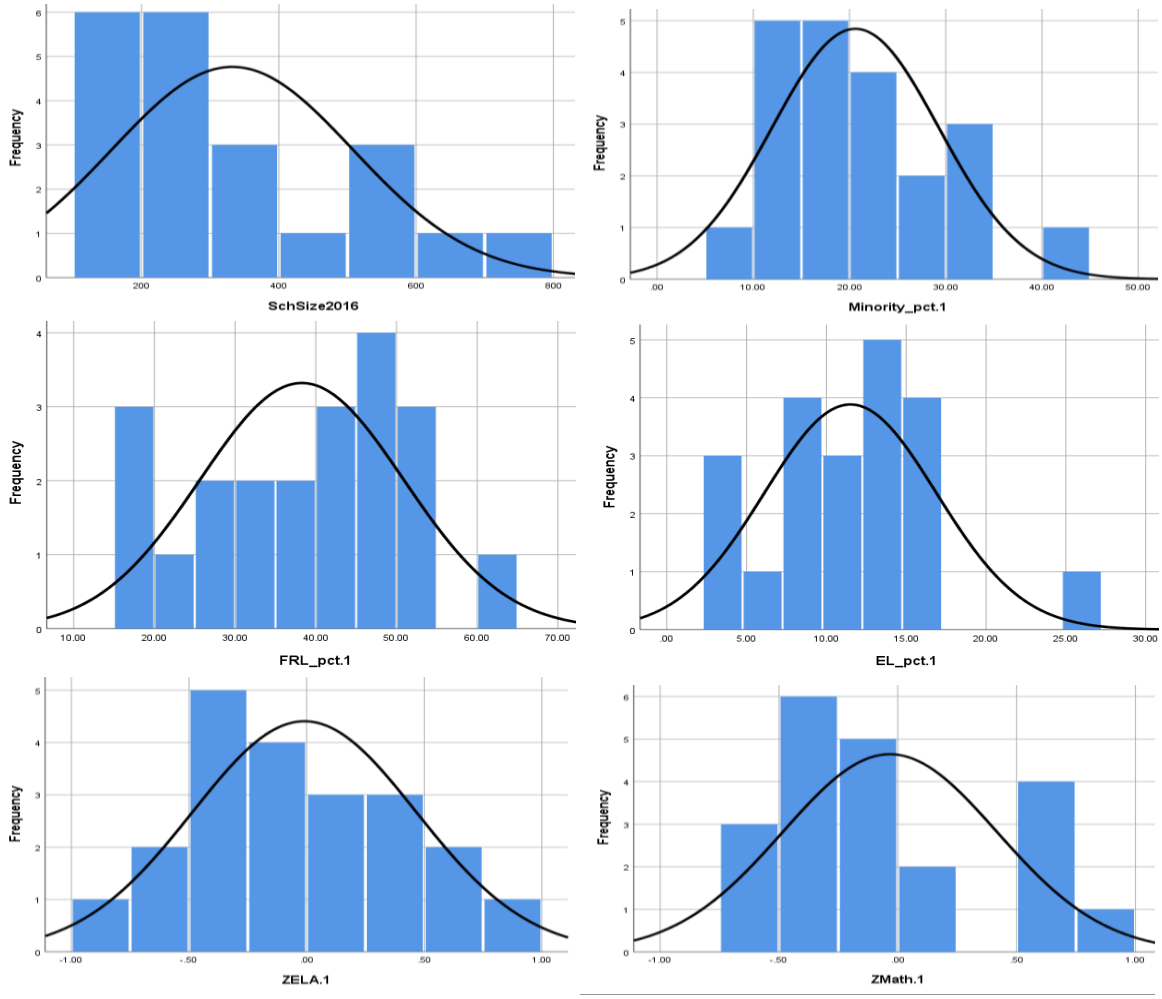


Figure A3. Distribution of the SEED Schools' Demographic Characteristics and Baseline Achievement Scores

Because SEED was a school-level intervention, all principals, assistant principals, teachers, and students from the participating sites were invited to participate in the evaluation. Table A3 provides the number of principals and assistant principals, teachers, and students across 21 SEED participating sites by school year based on the school administrative data (https://www.cde.state.co.us/cdereval/staffcurrent).

[15] To allow for cross-grade level comparisons, the within-grade-school mean scores were converted to z-scores using the state means and standard deviations calculated from individual student-level data within grade, within test year. See Data Analysis Plan section for more information about the methods used to convert scale scores into z-scores.

Table A3. Number of Principals, Assistant Principals, Teachers, and Students by School Year

Participants	2015–16 (Baseline)	Full Implementation			
		2016–17 (Year 1)	2017–2018 (Year2)	2018–19 (Year 3)	2019–20 (Year 4)
Number of principals (assistant principals)	21 (11)	21 (11)	22[a] (10)	21[a] (10)	21[a] (10)
Number of teachers (range per school)	492 (12–43)	495 (12–43)	492 (13–44)	502 (12–46)	500 (13–47)
Number of students (range per school)	7,069 (84–715)	7180 (141–755)	7348 (139–827)	7320 (133–828)	7179 (118–839)

[a] One of the participating schools had two principals.

SEED principals. Within SEED Schools, principals and assistant principals were involved in SEED in various ways, such as participating in the principal learning communities and using SEED PAK to support teacher PD.

SEED teachers vs. non-SEED teachers (non-matched). Within SEED Schools, teachers are able to participate in SEED in various ways, from taking formal SEED courses to reading a SEED blog or completing a SEED PAK resource. Of various types of SEED activities, certain types of activities were more likely to have an impact on teacher practices and outcomes, including

- SEED course participant (individual who participated in at least 80% of the TLC, PPS, independent study, and book study)
- SEED PAK participant (individual who completed at least eight SEED PAK resources within a school year)
- SEED actor (individual who reported applying what they learned from SEED in the classroom on a *weekly* or *daily* basis)
- SEED facilitator

When comparing the difference between SEED teachers and non-SEED teachers (i.e., evaluation questions that compare the difference between SEED and non-SEED teachers), teachers who met at least one of the above criteria were identified as SEED teachers. Teachers who did not meet any of the above criteria were identified as non-SEED teachers.

Non-SEED Matched Comparison Schools

As mentioned previously, six study samples were analyzed to examine the impact of SEED on student achievement outcomes. PSM was employed to identify a group of comparison schools for each study sample; the matched comparison schools were drawn from the pool of comparison schools across the state of Colorado. Table A4 shows all key covariates that were used in the matching for each study sample. However, different variables were created and utilized in different study sample, as appropriate, to achieve the best matching results based on the characteristics of each unique study sample. As shown in Table A4, for instance, for study sample 1 (S1), the covariates used in the matching include SmallSch, MID, HIGH, ELMMID, MIDHIGH, K12, Remote, MinorityGP, FRLGP1, FRLGP2, ELGP1, ELGP2, and ELA_0. For study sample 2 (S2), the covariates included in the matching include SmallSch, BuildingGP, Remote, MinorityGP, FRLGP, ELGP, and ELA_0.

Table A4. Baseline Covariates Included in the Matching by Study Sample

Characteristics	Variables	Definition	Study Samples					
			S1	S2	S3	S4	S5	S6
School size	SmallSch	0 = student enrollment > 400 1= student enrollment <= 400	x	x	x	x	x	x
Building type	MID, HIGH, ELMMID, MIDHIGH, K12	Five dummy variables were created using elementary schools as the reference group—MID, HIGH, ELMMID, MIDHIGH, and K12.	x		x	x		x
	BuildingGP	0 = elementary schools 1 = middle and/or high schools		x			x	
Locale	Remote	0 = non-remote[16] 1 = remote	x	x	x	x	x	x
Percentage of minority students	MinorityGP1, Minority GP2	% Minority was recoded into a categorical variable: 0 = % Minority <= 25%; 1 = % Minority between 26 and 50%; 2 = % Minority >= 51%. Two dummy variables were created using 0 as the reference group.			x	x		x
	MinorityGP	% Minority was recoded into a categorical variable: 0 = % Minority <= 25%; 1 = % Minority between 26 and 50%.	x	x			x	
Percentage of FRL students	FRLGP1, FRL GP2	% FRL was recoded into a categorical variable: 0 = % FRL <= 25%; 1 = % FRL between 26 and 50%; 2 = % FRL >= 51%. Two dummy variables were created using 0 as the reference group.	x		x	x		x
	FRLGP	% FRL was recoded into a categorical variable: 0 = % FRL <= 25%; 1 = % FRL between 26 and 50%.		x			x	
Percentage of EL students	ELGP1, ELGP2	% EL was recoded into a categorical variable: 0 = % EL <= 10%; 1 = % EL between 11 and 20%; 2 = % EL >=	x		x	x		x

[16] All SEED schools were in the outlying city, outlying town, or remote areas. Before the matching, schools that were not in these types of areas were removed from the dataset.

Characteristics	Variables	Definition	Study Samples					
			S1	S2	S3	S4	S5	S6
		21%. Two dummy variables were created using 0 as the reference group.						
	ELGP	% EL was recoded into a categorical variable: 0 = % EL <= 10%; 1 = % EL between 11 and 20%		x			x	
School-mean student achievement at baseline	ELA_0 / $Math_0$	School mean ELA/math (z-scores) for all students and subgroups at baseline[17]	x	x	x	x	x	x

PSM was conducted using the MatchIt package in R to identify a matched comparison group for each of the study samples. For different datasets, different matching algorithms were applied to achieve the best matching results. They are:

- ***Nearest matching.*** The nearest matching with a caliper of 0.25 and a matching ratio of 5 was employed to identify a matched comparison group for Study 1 and Study 2. With nearest matching, matching is done using a distance measure specified by the distance option. With nearest matching, the SEED schools that did not have similar matches in the potential comparison pool were removed from the matching and the analysis.
- ***Full matching***. CDE masks data for subgroups that have a sample size smaller than 16. As a result, the final sample sizes for student subgroups that were retained in the impact analyses were quite small. Therefore, for Studies 2, 3, 5, and 6, the full matching algorithm was used to minimize a weighted average of the estimated distance measure between each treated subject and each control subject within each subclass. To ensure the best matching results, schools that did not share the same demographic characteristics as the SEED schools were removed from the dataset before matching. For instance, for Study 2, none of the SEED schools were categorized under MinGP2, FRLGP2, or ELGP2. Therefore, the comparison schools that were categorized under MinGP2, FRLGP2, or ELGP2 were removed before matching. This approach was to ensure that the comparisons remaining in the dataset were as similar to SEED schools as possible before matching. Then, full matching was conducted to generate a weights variable to adjust for the baseline difference between the remaining SEED and non-SEED schools. With full matching, the remaining SEED and non-SEED schools were retained in the dataset, and the weights created by MatchIt was applied in the impact analysis to ensure that the treated and control groups were weighted up to be similar.

After the matching process was complete for each study sample, balance diagnostics were conducted to check the quality of the matches (Rubin, 2001). The diagnostic criteria suggested by Rubin (2001) below were used to check covariate balances:

[17] Appropriate baseline achievement data were used in the matching depending on the study sample. For instance, the baseline achievement data for all students were used when the matching was conducted with the all-students sample. The baseline achievement data for FRL students were used when the matching was conducted with the FRL sample only. The baseline achievement data for MINORITY students were used when the matching was conducted with racial/ethnic minority (non-white) sample only.

- The ratio of the variances of the propensity scores (PS) in the two groups must be close to 1.0. Rubin (2001) suggests that the variance ratios should be between 0.5 and 2.0.
- The difference in the means of the propensity scores in the two groups being compared must be small. Rubin (2001) suggests that the standardized differences of means should be less than 0.25.
- For the percent of balance improvement, the larger the percent, the better the PSM results.

Table A5 shows the final sample sizes and the balanced baseline characteristics for the SEED schools and comparison schools, as the result of the matching, for each study sample at baseline. Specifically, the ratio of the variance of the propensity scores (PS) ranged from 0.53 and 1.38, which is within the range recommended by Rubin (2001). The standardized mean differences on all covariates, except one, were smaller than 0.25, which also met Rubin's recommendation. All covariates used in the matching were also included in all follow-up analyses and impact analyses to account for the leftover imbalance at baseline. The state of baseline equivalence for the samples used in the Y1, Y2, and Y3 outcome analyses are reported in Appendix C.

Table A5. Baseline Characteristics of the Six Study Samples

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
1	**All Students with ELA Outcome[18]**								
	SmallSch	19	0.68	0.48	81	0.66	0.48	0.94 (0.017 / 0.018)	0.04
	MID	19	0.16	0.37	81	0.14	0.34		0.07
	HIGH	19	0.16	0.37	81	0.15	0.36		0.03
	ELMMID	19	0.11	0.32	81	0.12	0.33		0.05
	MIDHIGH	19	0.16	0.37	81	0.16	0.37		0.01
	K12	19	0.05	0.23	81	0.03	0.18		0.10
	Remote	19	0.16	0.37	81	0.15	0.36		0.03
	MinorityGP	19	0.26	0.45	81	0.26	0.44		0.01
	FRLGP1	19	0.58	0.51	81	0.54	0.50		0.07
	FRLGP2	19	0.21	0.42	81	0.23	0.42		0.05
	ELGP1	19	0.42	0.51	81	0.41	0.50		0.01
	ELGP2	19	0.05	0.23	81	0.03	0.18		0.10
	ELA_0	19	-0.02	0.45	81	0.01	0.39		0.06
2	**Minority Students with ELA Outcome[19]**								
	SmallSch	7	0.14	0.38	44	0.15	0.36	1.38 (0.058/0.042)	0.03
	BuildingGP	7	0.71	0.49	44	0.59	0.50		0.24
	FRLGP	7	0.43	0.53	44	0.44	0.50		0.03
	MinorityGP	7	0.29	0.49	44	0.35	0.48		0.13
	ELGP	7	0.57	0.53	44	0.68	0.47		0.22

[18] Two SEED schools were removed from the study sample due to lack of matched comparisons from the potential comparison schools.

[19] The variable Remote was not included in the matching because none of the SEED schools remaining in the final sample were in remote areas. Therefore, other non-SEED schools in remote areas were also removed from the dataset prior to matching.

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
	ELA_0	7	-0.21	0.36	44	-0.23	0.24		0.08
3	**FRL Students with ELA Outcome**								
	SmallSch	15	0.60	0.51	159	0.71	0.46	0.53 (0.023 / 0.043)	0.24
	MID	15	0.20	0.41	159	0.27	0.44		0.16
	HIGH	15	0.13	0.35	159	0.13	0.33		0.02
	ELMMID	15	0.13	0.35	159	0.09	0.28		0.16
	MIDHIGH	15	0.13	0.35	159	0.10	0.30		0.12
	Remote	15	0.07	0.26	159	0.07	0.25		0.01
	MinorityGP	15	0.33	0.49	159	0.42	0.50		0.17
	FRLGP1	15	0.60	0.51	159	0.64	0.48		0.09
	FRLGP2	15	0.13	0.35	159	0.13	0.34		0.01
	ELGP1	15	0.47	0.52	159	0.49	0.50		0.04
	ELGP2	15	0.07	0.26	159	0.07	0.26		0.01
	ELA_0	15	-0.40	0.29	159	-0.35	0.21		0.19
4	**All Students with Math Outcome** [20]								
	SmallSch	18	0.67	0.49	72	0.77	0.43	0.94 (0.33 / 0.35)	0.23
	MID	18	0.17	0.38	72	0.15	0.36		0.04
	HIGH	18	0.17	0.38	72	0.16	0.37		0.02
	ELMMID	18	0.11	0.32	72	0.10	0.31		0.02
	MIDHIGH	18	0.17	0.38	72	0.20	0.41		0.09
	K12	18	0.00	0.00	72	0.03	0.17		0.19
	Remote	18	0.11	0.32	72	0.15	0.36		0.11
	MinGP1	18	0.28	0.46	72	0.26	0.44		0.04
	MinGP2	18	0.00	0.00	72	0.03	0.18		0.21
	FRLGP1	18	0.61	0.50	72	0.64	0.48		0.05
	FRLGP2	18	0.17	0.38	72	0.20	0.40		0.07
	ELGP1	18	0.39	0.50	72	0.33	0.47		0.12
	ELGP2	18	0.06	0.24	72	0.04	0.21		0.05
	$Math_0$	18	-0.01	0.41	72	-0.04	0.40		0.08
5	**Minority Students with Math Outcome**								
	SmallSch	7	0.14	0.38	51	0.10	0.30	0.98 (0.47 / 0.48)	0.15
	BuildingGP	7	0.71	0.49	51	0.77	0.42		0.13
	MinorityGP	7	0.43	0.53	51	0.52	0.50		0.18
	FRLGP	7	0.29	0.49	51	0.32	0.47		0.08
	ELGP	7	0.57	0.53	51	0.44	0.50		0.27*
	$Math_0$	7	-0.15	0.37	51	-0.16	0.23		0.04
6	**FRL Students with Math Outcome**								
	SmallSch	15	0.60	0.51	257	0.56	0.50	1.00 (0.34 / 0.34)	0.07
	MID	15	0.20	0.41	257	0.24	0.43		0.08
	HIGH	15	0.13	0.35	257	0.15	0.36		0.06
	ELMMID	15	0.13	0.35	257	0.13	0.34		0.00
	MIDHIGH	15	0.13	0.35	257	0.11	0.31		0.08

[20] Three SEED schools were removed from the study sample due to lack of matched comparisons from the potential comparison schools

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
	Remote	15	0.07	0.26	257	0.06	0.24		0.03
	MinGP1	15	0.33	0.49	257	0.29	0.45		0.10
	MinGP2	15	0.00	0.00	257	0.03	0.17		0.18
	FRLGP1	15	0.60	0.51	257	0.59	0.49		0.03
	FRLGP2	15	0.13	0.35	257	0.14	0.35		0.03
	ELGP1	15	0.47	0.52	257	0.42	0.50		0.09
	ELGP2	15	0.07	0.26	257	0.09	0.29		0.09
	$Math_0$	15	-0.44	0.30	257	-0.39	0.28		0.21

* The standardized mean difference on the variable was greater than 0.25, suggesting that the SEED and non-SEED schools were different on the percentage of EL students served at baseline after matching and adjusting for weights. In other words, there was a much higher percentage of EL students in the SEED schools compared to non-SEED schools.

Data Collection Methods

This section describes all data collection conducted throughout the project period, including the pilot testing and baseline data collection year (2015–16) as well as four years of full implementation (2016–2020). Institutional review board (IRB) approval was obtained in 2015 before school recruitment. All participating principals and teachers provided consent online to participate in the evaluation. Documentation of student parental consent was waived, but parents could choose to opt their children out of the survey. Throughout the project period, instruments were revised as needed based on quality and informativeness of the data. The teacher survey, in particular, was revised annually to reflect changes made to SEED offerings. Table A6 shows the data collection timeline and instruments that were used throughout the full implementation period.

Table A6. Data Collection Timeline Throughout the Project Period

Instrument	Pilot Sample		Full Implementation				
	2015 (Baseline)	2016 (Follow-Up)	2016 (Baseline)	2017 (Y1)	2018 (Y2)	2019 (Y3)	2020 (Y4)
Fidelity of Implementation Matrix	X			X	X	X	X
Principal baseline interview	X						
Principal follow-up interview		X		X			
Teacher baseline interview	X		X				
Teacher follow-up interview		X		X			
IC baseline interview	X						
IC follow-up interview		X		X			
Principal baseline survey	X						
Principal follow-up survey		X		X	X	X	X
Teacher baseline survey	X		X				
Teacher follow-up survey		X		X	X	X	X
Student engagement survey (3rd–5th)			X	X	X	X	X
Student engagement survey (6th–10th)			X	X	X	X	X

Note. All data collection occurred annually throughout the project period except the 2015 baseline data collection, which occurred in November/December 2015.
All = all sample, T1 = time 1 assessment, T2 = time 2 assessment, T3 = time 3 assessment, T4 = time 4 assessment.

All instruments were developed and tested during the pilot year (2015–16), except the student engagement surveys, which were first administered at the baseline of full implementation (May/June 2016). The final implementation year was the 2019–20 school year; however, the implementation was disrupted by the COVID-19 pandemic in March 2020. All participating schools were closed for the remainder of the school year. NW BOCES continued their PD delivery completely online during school closures. McREL administered the teacher survey, principal survey, and student survey online, as planned. However, due to school closures, the state assessments and activities related to teacher evaluations were suspended. As a result, several key data elements for the final evaluation were unavailable, including student achievement data and teacher evaluation ratings. Additionally, due to the disruption caused by COVID-19, survey response rates across all participant groups were lower than for previous administration years. Each instrument and the corresponding response rates are briefly described in the following sections.

Fidelity Assessment

McREL evaluators developed a fidelity of implementation (FOI) matrix to examine and monitor the level of implementation throughout the project period. As shown in Table A7, eight fidelity indicators were developed to measure all four SEED strategies across three main categories: SEED creation, SEED delivery, and SEED participation. Indicators of SEED creation and SEED delivery were measured at the program level. Indicator scores were combined to create a program-level score for each category, and a threshold for implementation with fidelity at the program level was defined as 3. SEED participation indicators were measured at the teacher level, rolled up to the school level, and then rolled up to the program level. A threshold for implementation with fidelity at the program-level was also defined as 3. Various data sources were used to assess each of the specified fidelity indicators. See Project Record and Extant Data section for more details regarding each of the data sources.

The FOI matrix contains a quantitative system for rating each key component of SEED. Level of implementation serves as the scoring system for the adherence index (low to high; 1 to 3). A mean score was determined for each stage of the project (initial planning, technology development, content development, phased-in implementation, full implementation, and sustainability). Means across all key components were calculated to determine a "score" for the dosage index. For example, each teacher had data indicating whether they had SEED PD linked to specific teacher performance indicators. The percentages of teachers at each school who met this criterion (yes or no) were averaged across all schools to get a "score" for this SEED participation key component for the entire sample. The FOI matrix was pilot tested with the pilot teacher and principal samples in 2015–16.

Table A7. SEED Fidelity of Implementation Matrix

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to program level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure	Expected years of fidelity measurement
1. Topics for learning strands for PD are selected based on teacher needs	Learning strands chosen based on teacher need	Program	PD committee and content development team (CDT) meeting minutes	By June, meeting minutes put on Google Drive	Percent of learning strands that meet criteria. Score based on percent: (1) low; (2) med; (3) high.	3	N/A	Percent of learning strands that meet criteria. Score based on percent: (1) low; (2) med; (3) high. Threshold=3.	Program	Years 1–4 (2016–2020)
2. Evidence-based PD is selected by ICs and CDTs for inclusion in the SEED PAK	PD activity has theoretical evidence base behind it	PD activity	SEED PAK resources reviewed to determine whether they contain strategies that are supported by research-based theory[21]	By Sept., McREL reviews PD against research-based theory	Score assigned to each activity: 0 = no indication of theoretical base; and 1 = identified theoretical base	1	% of 20 randomly selected SEED PAK resources with score of 1. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3	% of 20 randomly selected SEED PAK resources with score of 1. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3.	SEED PAK resources throughout the project	Years 1–4 (2016–2020)
3. ICs and CDTs create in-person TLC activities	TLCs include at least two in-person activities per semester	Program	ICs' syllabi for the TLCs	By Sept. and Feb., SEED TLC syllabus put on Google Drive	Percent of TLCs that include at least 2 in-person activities per semester. Score based on percent: (1) low; (2) med; (3) high.	3	N/A	Percent of TLCs that include at least 2 in-person activities per semester. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3	Program	Years 1–4 (2016–2020)
4. ICs and CDTs create	TLCs that have at least one	Program	ICs' syllabi for the TLCs	By Sept. and Feb., TLC syllabus	Percent of TLCs that have a least one hour per week of virtual	3	N/A	Percent of TLCs that have a least one hour per	TLCs	Years 1–4 (2016–2020)

[21] The McREL evaluation team randomly selected 20 PD resources from SEED PAK annually to determine whether the resources are backed up by the evidence-based literature.

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to program level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure	Expected years of fidelity measurement
virtual TLC activities	hour per week of virtual activities			posted on Google Drive	activities. Score based on percent: (1) low; (2) med; (3) high.			week of virtual activities. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3		
5. ICs format TLC delivery using evidence-based delivery standards	TLCs utilize the four evidence-based TLC standards from Vescio et al. (2008) model.	Program	TLC reviewed against Vescio et al. (2008) TLC standards [22]	Feb. and Sept., McREL reviews each TLC's syllabus put on the Google Drive	Percent of TLCs that utilize the four evidence-based TLC standards. Score based on percent: (1) low; (2) med; (3) high.	3	N/A	Percent of TLCs that utilize the four evidence-based TLC standards. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3.	Program	Years 1–4 (2016–2020)
Total Score for SEED PD Creation Components								**Mean of the five indicators. Threshold = 3.**		
6. ICs facilitate blended learning TLCs	TLC is hosted for each learning strand	Program	ICs' syllabi for TLCs and content development team meeting minutes determining learning strands	By Aug. and Jan., documents are put on Google Drive	Percent of learning strands that have TLCs hosted as indicated in syllabi. Score based on percent: (1) low; (2) med; (3) high.	3	N/A	Percent of learning strands that have TLCs hosted as indicated in syllabi. Score based on percent: (1) low; (2) med; (3) high. Threshold=3.	Program	Years 1–4 (2016–2020)
Total Score for SEED PD Delivery Component								**Same as indicator 6. Threshold = 3.**		
7. SEED PD is linked to specific teacher performance indicators by	Principal or teacher assigns at least one SEED PD in COPMS	Teachers	SEED system linking COPMS with	By June, SEED COPMS data will be provided to McREL	0 = No 1 = Yes	1	School level: % of teachers with score of 1 in each school. Score based on percent: (1) low (0–	Percent of schools that have score of 2. Score based on percent: (1) low; (2) med; (3) high. Threshold=3.	All schools in which the intervention is being implemented	Years 1–4 (2016–2020)

[22] ICs created a syllabus for each TLC. The McREL evaluation team reviewed TLC syllabi and compared the syllabi against the evidence-based professional/teacher learning community practices as identified by Vescio et al. (2008).

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to program level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure	Expected years of fidelity measurement
teachers or principals[23]			SEED platform[24]				19%); (2) med (20–50%); (3) high (51-100%). Threshold=2			
8. Teachers complete SEED PD[25]	Teacher completes at least one facilitated SEED PD **OR** self-directed completion of at least 8 SEED PAK activities per academic year	Teachers	SEED platform PD completion data and Innovation Coach TLC gradebook data[26] and other facilitated use (participation score must be at least 80% to be "complete")	By June, SEED platform data will be provided to McREL and by Jan. and June, IC "gradebook" and facilitated use data will be uploaded on Google Drive.	0 = No 1 = Yes	1	School level: % of teachers with score of 1 in each school. Score based on percent: (1) low (0–19%); (2) med (20–50%); (3) high (51–100%). Threshold = 2	Percent of schools that have score of 2. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3.	All schools in which the intervention is being implemented	Years 1–4 (2016–2020)
Total Score for SEED Participation Component								**Mean of the two indicators. Threshold = 2.**		

Note. Unless otherwise noted, when a score was assigned based on percent, 1= low (0-33%); 2 = med (34-66%); 3 = high (67–100%).

[23] This indicator is measured by the number of teachers who were assigned, self-assigned, or assigned by others, with at least one SEED PAK resource during the school year.

[24] This is a digital system that links the Colorado Performance Management System (COPMS) with SEED. Annually, RANDA Solutions provided the data to determine whether teachers have SEED PAK activities connected to their professional growth plans in the COPMS.

[25] SEED PD included SEED PD offerings (i.e., TLCs, PPS, SEED PAK independent study, book study, and others [i.e., Alt-licensure, induction, EL modules, SEED facilitator]) and SEED PAK (i.e., complete at least 8 resources within one school year).

[26] ICs were responsible for tracking teacher participation in SEED offerings; these data were used to determine teacher completion status across SEED offerings.

Principal Baseline and Follow-Up Interviews

Two types of principal interview protocols were developed: baseline and follow-up. The baseline principal interview protocol was developed in fall 2015 and was designed to understand current systems or processes in place at the school and district levels to support principal involvement in teacher professional growth, what principals perceived their roles to be regarding teacher professional growth, and whether they were satisfied with their roles and why or why not. All 21 school principals were interviewed.

The principal follow-up interview protocol was developed in spring 2016 (pilot follow-up/baseline full implementation) and was designed to understand principals' current roles in and current practices for teacher professional growth, any changes in beliefs or practices since SEED was implemented during the pilot, recommendations for changes to SEED, and success with SEED. All 21 principals from the SEED schools were interviewed again using the principal follow-up interview protocol.

The protocol was revised in spring 2017 (Y1 full implementation) by adding one extra question about what SEED meant to them (i.e., principals). A stratified sample of eight principals were interviewed using the slightly revised principal follow-up interview protocol. The principal selection process was based on each school's fidelity score for SEED participation. Within each quartile, two principals were selected for interview. When there were different grade levels in the quartile, one principal from each grade level (primary and secondary) was purposefully selected. During the 2017 interview, there was no primary school in the 3rd quartile, so the 4th quartile was oversampled. Additionally, one principal within the 3rd quartile did not respond to the interview invitation; hence, another principal within the same quartile with the nearest percentage was selected and completed the interview.

All interviews were conducted over the phone. Each interview was about 30 minutes during each round of data collection. Starting in 2017–18, principal interviews were removed from the data collection to reduce the redundancy of information collected over time.

Innovation Coach (IC) Interviews

An IC interview protocol was developed during the pilot baseline to understand IC perceptions of their readiness to support teachers; whether SEED infrastructure was adequate to support teachers; how SEED supported their work with teachers; successes and barriers with teachers; and barriers with SEED. The same protocol was used in May 2016 and 2017 (baseline and Y1 full implementation). All interviews were conducted over the phone and each interview was about 30 minutes. Starting in 2017–18, IC interviews were removed from the data collection to reduce the redundancy of information collected over time.

Teacher Baseline and Follow-Up Interviews

Two types of teacher interview protocols were developed: baseline and follow-up. At baseline in fall 2015, the teacher interview protocol was designed to understand current systems or processes in place at the school and district levels to support principal involvement in teacher professional growth, what teachers would like principals' roles to be in their professional growth and what their roles are, whether they were satisfied with principals' roles, and why or why not. In addition, teachers were asked to describe their current practices in their own professional growth and how they chose PD opportunities and strategies. A stratified sample of 12 pilot teachers was interviewed

using the teacher baseline interview protocol. The same protocol was used again in spring 2016 to collect baseline data for full implementation from the non-pilot teachers. Another stratified sample of 12 teachers was interviewed using the baseline protocol.

The teacher follow-up interview protocol was developed in spring 2017 (Y1 full implementation). The interview protocol was designed to understand teachers' perceptions of their principal's current role in and practices for teacher professional growth; any changes in principals' and their own beliefs or practices since SEED was implemented; any changes in teachers' own approach to professional growth, beliefs about what it means to be a successful teacher, and practice in classroom since SEED was implemented; any areas of SEED that could be improved; and success with SEED. A stratified sample of 12 teachers (including pilot and non-pilot teachers) was interviewed using a slightly revised teacher follow-up interview protocol. Each interview was about 30 minutes during each round of data collection. All interviews were conducted over the phone. Starting with 2017–18, teacher interviews were removed from the data collection to reduce the redundancy of information collected over time.

In terms of the stratification strategy during the pilot, teacher samples were stratified based on current data available from CDE: the school's highest grade served (primary or secondary), number of students (median split), and percentage of students who scored at least proficient on the TCAP assessment (median split). The percentage of the 12 teachers selected for each stratum was based on the percentage of schools that fell into each stratum (e.g., 19% of schools fell into a stratum, which indicated two of the 12 teachers should be sampled). Starting in the 2017 data collection phase, the selection process was changed to gather information from a representative sample of TLC and PPS participants. Specifically, each teacher was to be assigned a score based on their level of participation, and the plan was to use the participation score to select eight teachers from the TLC/PPS users stratified by participation score. Four additional teachers from the non-TLC users (varying levels of SEED PAK use) were also to be selected. However, for the 2017 teacher sample selection, the process was revised slightly. Specifically, based on the participation data, only two teachers completed activities on the SEED PAK; hence, these two teachers were invited to participate in an interview. Also, based on the participation scores, there were only three values for quartiles, so the 10 remaining teachers were selected across the three scores, with four teachers being from the largest quartile and three teachers from the other two quartiles. When there were different grade levels in the quartile, one teacher from each grade level (primary and secondary) was purposefully selected.

All interviews were conducted over the phone. Each interview was about 30 minutes during each round of data collection. Starting in 2017–18, principal interviews were removed from the data collection to reduce the redundancy of information collected over time.

Principal Baseline and Follow-Up Surveys

Two types of surveys were developed for principals and assistant principals: baseline and follow-up. In the baseline principal survey developed in fall 2015, the questions were designed to understand principals' perceptions of school approach to PD. Specifically, 12 items adapted from the 2014 North Carolina Teacher Working Conditions survey (New Teacher Center, 2014) and 4 items developed by McREL were included in the survey. All items were rated on a 1 to 6 (*strongly disagree* to *strongly agree*) scale. Exploratory factor analysis (EFA) was conducted to identify the underlying

constructs of the 16 items used to measure school approach to PD.[27] However, due to the small sample size (28 principals and assistant principals responded to the survey at baseline in fall 2015), results from EFA may not be reliable (Comrey & Lee, 1992). Therefore, McREL researchers utilized the findings from EFA as a supplemental resource to guide the identification of the constructs and items that are appropriate to measure the constructs.

The principal follow-up survey was developed in May 2016 (baseline full implementation) and used again annually throughout the implementation period. In addition to the 16 questions about school approach to PD, additional items were included—specifically, 6 items to assess principal perception of SEED's utility to support teacher PD (see Table A6)[28] and 3 open-ended questions asking about areas in need of improvement, success with SEED, and additional PD offered to teachers in the current school year.

Principal surveys were administered online with all SEED principals and assistant principals throughout the project period. Table A8 shows the response rate and survey length by data collection phase. Because SEED is a school-level intervention, all principals were exposed to SEED beginning in fall 2015; hence, the 2015 principal baseline survey data served to understand how SEED changed principals' perceptions and practices regarding teacher PD. The low response rate during the 2020 follow-up survey may be attributed to the disruption caused by the 2020 COVID-19 pandemic.

Table A8. Principal Survey Response Rate by Data Collection Phase

Data Collection Phase	Number Invited	Number Responded	Response Rate	Survey Length
2015 Principal Baseline Survey	32	30	93.8%	10 minutes
2016 Principal Follow-Up Survey	32	24	75%	15 minutes
2017 Principal Follow-Up Survey	32	32	100%	15 minutes
2018 Principal Follow-Up Survey	32	32	100%	15 minutes
2019 Principal Follow-Up Survey	31	29	93.5%	15 minutes
2020 Principal Follow-Up Survey	31	18	58.1%	15 minutes

Table A9 shows the items by construct measured in the principal surveys, including principal baseline survey (PB) and principal follow-up survey (PF). These constructs were the outcomes of interest measured in the principal surveys.

Table A9. Constructs Measured in Principal Surveys

Constructs (Data Sources)	Items
School offering evidence-based PD (PB, PF)	• The PD my school offered enhanced teachers' ability to implement instructional strategies that meet diverse student learning needs. • The PD my school offered provided ongoing opportunities for teachers to work with colleagues to refine teaching practices. • The PD my school offered enhanced teachers' abilities to improve student learning.

[27] Principal axis factor analysis with varimax rotation was conducted. Based on the scree plot, two-factor and three-factor solutions were requested. Interpretation of the results in light of the conceptual framework suggests three-factor solution. The first factor accounted for 45% of the variance, the second factor accounted for 11%, and the third factor accounted for 6%, with cumulative variance of 62%.

[28] Items were measured on a 1 to 6 (*strongly disagree* to *strongly agree*) scale.

Constructs (Data Sources)	Items
	• The professional learning opportunities my school offered were aligned with the school's improvement plan. • The PD my school offered deepened teachers' content knowledge. • My school's PD offerings were data-driven. • I recommended and planned PD based on needs identified through the teacher evaluation process.
School-provided time and resources to access PD (PB, PF)	• An appropriate amount of time was provided for PD at my school. • Sufficient resources were available for PD in my school.
Principal Engagement in Teacher PD (PB, PF)	• In this school, follow-up was provided from PD. • The PD my school offered was evaluated and results were communicated to teachers. • Teachers were encouraged to reflect on their own practice. • The current teacher evaluation systems provide information that allows me to be supportive of teacher PD. • I understand what PD support teachers need. • During conversations with teachers regarding their professional growth (i.e., improvement on the teacher evaluation rubric and in knowledge and implementation of best practices), I feel prepared to be supportive.
School-offered individualized teacher PD (PB, PF)	• The PD my school offered was differentiated to meet the individual needs of teachers.
SEED utility to support teacher PD (PF)	• SEED content is useful for teachers' PD. • The SEED system has PD that is relevant to teachers' needs as identified by the state evaluation rubric (RANDA). • SEED PD enabled me to support teachers' professional growth. • The integration of the SEED PAK and RANDA is easy to use. • The integration of the SEED PAK and RANDA allowed me to better track teacher professional growth plans. • The integration of the SEED PAK and RANDA helped facilitate conversations with teachers about professional growth.

Table A10 shows Cronbach's alphas for the constructs measured in the principal survey over time. Overall, reliability estimates were acceptable across all scales over time ($a >= 0.70$) with one exception—the internal consistency of the items measuring principal engagement in teacher PD was 0.61 in Y4.

Table A10. Reliability Estimates Over Time: Constructs Measured in the Principal Surveys

Constructs	Pilot		Full Implementation									
	Baseline (fall 2015)		Baseline (spring 2016)		Y1 (spring 2017)		Y2 (spring 2018)		Y3 (spring 2019)		Y4 (spring 2020)	
	n	A	n	α	n	α	n	α	n	α	n	α
School offering evidence-based PD	28	0.90	24	0.78	31	0.93	32	0.80	28	0.92	18	0.85
School-provided time and resources to access PD[a]	29	0.92	24	0.91	32	0.96	32	0.87	29	0.94	18	0.81

Constructs	Pilot		Full Implementation									
	Baseline (fall 2015)		Baseline (spring 2016)		Y1 (spring 2017)		Y2 (spring 2018)		Y3 (spring 2019)		Y4 (spring 2020)	
	n	A	n	α	n	α	n	α	n	α	n	α
Principal engagement in Teacher PD	29	0.83	24	0.76	30	0.81	32	0.75	28	0.71	18	0.61
SEED utility to support teacher PD	--	--	16	0.88	27	0.94	27	0.90	27	0.93	15	0.83

[a] The construct includes two items. Hence, α was not conducted; rather the value was the correlation between these two items.
[b] This construct includes one item; hence, α was not calculated.
Note. Constructs measured by one item are not reported in this table.

Teacher Baseline and Follow-Up Surveys

Two types of surveys were developed for teachers: baseline and follow-up. The baseline teacher survey developed in the fall of 2015 was designed to understand school approach to PD; access to evidence-based, up-to-date content; and opportunities to collaborate with job-alike peers. To measure school approach to PD, 12 items adapted from the 2014 North Carolina Teacher Working Conditions survey (New Teacher Center, 2014), 7 items adapted from the Teacher Perceptions of Professional Learning survey (Yates & Harris, 2003), and 1 item developed by McREL were included. Factor analysis was conducted to identify the underlying constructs explaining teacher perception of school approach to PD using the teacher survey data collected at baseline for the pilot and baseline for the full implementation.[29] McREL also developed two items to assess the extent to which teachers agreed they had access to evidence-based and up-to-date PD content through district, BOCES, or school initiatives. All items were rated on a 1 to 6 (*strongly disagree* to *strongly agree*) scale. Opportunities to collaborate with job-alike peers was assessed with a single item on a 1 to 5 (*daily*, *weekly*, *monthly*, *less than once/month*, *never*) scale, followed by an additional item asking how the opportunities are organized (*formally organized by administrators*, *PD programs*, and/or *teachers*, and/or *informal meetings/conversations among teachers*). The same baseline survey was administered with the non-pilot teachers in May/June 2016 to gather the baseline data before full implementation.

The follow-up teacher survey was developed and administered with the pilot teachers in May 2016. The survey contained the same set of items from the baseline survey, including school approach to PD (20 items), access to evidence-based and up-to-date content items (2 items), and opportunities to collaborate with job-like peers (1 item). Additional items were included to (1) understand SEED's impact on teacher instruction and student learning (6 items); (2) teachers' PD (6 items); (3) teachers' experience with SEED components (i.e., TLC [3 items], IC [4 items], SEED Personalized Accessible Knowledge (PAK) [7 items]), and (4) SEED impact on teacher collaboration with peers (4 items).[30] All items were rated on a 1 to 6 (*strongly disagree* to *strongly agree*) scale. Two open-ended questions asking about areas in need of improvement and success with SEED were also included.

[29] Principal axis factor analysis with promax rotation was conducted. Based on the scree plot, three-factor and four-factor solutions were requested. Interpretation of the results in light of the conceptual framework suggests four-factor solution. The first factor accounted for 62% of the variance, the second factor accounted for 7%, the third factor accounted for 3%, and the fourth factor accounted for 2%, with cumulative variance of 73%.
[30] Items measuring SEED impact on teacher collaboration with peers were adapted from the Teacher Perceptions of Professional Learning survey (3 items) (Yates & Harris, 2003) and the Professional Development Activity Log (1 item) (Yoon, Garet, Birman, & Jacobson, 2006).

The follow-up survey was revised in May 2017. Specifically, revisions were made to the items that assess SEED's impact on teacher instruction and student learning, SEED's impact on teachers' PD, and teachers' experience with SEED components, to reflect changes made to the structure and definitions of SEED components during the full implementation. Additionally, three questions assessing teachers' growth mindset were added because ICs were recognizing changes in teacher mindset. These questions were adapted from the PATH Math Teacher Survey (Yaeger, 2017). In May 2018, the teacher follow-up survey was revised again to add items measuring teacher perception of the quality of SEED PAK and the SEED blog, as well as teacher perception of principal engagement in PD. The teacher survey also collected data on their perceptions regarding the extent to which PD content is up-to-date, PD content is evidence-based, and how frequently they apply what they have learned from SEED in their classrooms. Each of these constructs was measured by one item.

Table A11 shows the response rate and survey length by data collection phase. All teacher surveys were administered online. The numbers of teachers who were invited to take the survey were provided by the SEED staff; hence, these numbers were slightly different from the administrative data on the CDE website. The low response rate during the 2020 follow-up survey may be attributed to the disruption caused by the 2020 COVID-19 pandemic.

Table A11. Teacher Survey Sample, Response Rate, and Survey Length by Data Collection Phase

Data Collection Phase	Sample	Number Invited	Number Responded	Response Rate	Survey Length (minutes)
2015 Teacher Baseline Survey	Pilot teachers	55	42	76.4%	15
2016 Teacher Follow-Up Survey	Pilot teachers	55	37	67.3%	15
2016 Teacher Baseline Survey	Non-pilot teachers	477	296	62.1%	15
2017 Teacher Follow-Up Survey	All teachers	507[a]	281	55.4%	15
2018 Teacher Follow-Up Survey	All teachers	525	377	71.8%	15
2019 Teacher Follow-Up Survey	All teachers	545	414	76%	15
2020 Teacher Follow-Up Survey	All teachers	547	293	53.6%	15

[a] This number is provided by NW BOCES, which is different from the data published on CDE website. For the calculation of the response rate, NW BOCES's record is used.

Table A12 shows the items by construct measured in the teacher surveys, including teacher baseline survey (TB) and teacher follow-up survey (TF).

Table A12. Constructs Measured in Teacher Surveys

Constructs (Data Sources)	Items
Instructional practice-focused PD (TB, TF)	• I learned new and different ideas from my PD experiences. • The PD improved my knowledge of instructional strategies. • Knowledge gained from the PD improved my teaching skills.

Constructs (Data Sources)	Items
	• The PD increased my enthusiasm for teaching. • The PD encouraged me to reflect on aspects of my teaching. • The PD gave me useful ideas of how to improve student outcomes. • The PD updated my professional knowledge. • The PD I was offered deepened my content knowledge. • The PD I was offered was differentiated to meet my individual needs.
Data-driven PD (TB, TF)	• The professional learning opportunities I was offered were aligned with my school's improvement plan. • The PD I was offered was data-driven. • Teachers were encouraged to reflect on their own practice. • School leadership recommended and planned PD based on needs identified through the teacher evaluation process. • In my school, follow-up was provided from PD. • The PD my school offered was evaluated and results were communicated to teachers.
School-provided time and resources to access PD (TB, TF)	• An appropriate amount of time was provided for PD at my school. • Sufficient resources were available for PD in my school.
Student learning-focused PD (TB, TF)	• The PD I was offered enhanced my ability to implement instructional strategies that meet diverse student learning needs. • The PD I was offered provided ongoing opportunities for me to work with colleagues to refine teaching practices. • The PD I was offered enhanced my abilities to improve student learning.
Up-to-date PD (TB, TF)	• PD content is up-to-date.
Evidence-based PD (TB, TF)	• PD content is evidence-based.
Opportunity to collaborate (TB, TF)	• On average, to what extent do you have opportunities to collaborate with job-alike peers?
Growth mindset (TF)	• Some people are just born great teachers; some people are just born great teachers; if you're not, there's not much you can do to become a really great teacher. • If I really try hard, I can get even the most difficult or unmotivated student to learn. • I can improve my instruction through my efforts.
Quality of SEED PAK (TF)	• SEED PAK activities were a good use of my time. • SEED PAK has useful activities and content. • SEED PAK increased my knowledge of best practices.
Quality of SEED blog (TF)	• Reading the SEED blog is a good use of my time. • The SEED blog has useful information and content. • The SEED blog increased my knowledge of best practices.
Quality of SEED course (TF)	• SEED courses were a good use of my time. • SEED courses have useful activities and content. • SEED courses increased my knowledge of best practice.
SEED impact on teacher instruction	• What I learned from SEED taught me how to implement effective strategies in my classroom. • SEED content is directly relevant to teaching and learning in my school.

Constructs (Data Sources)	Items
and student learning (TF)	• I use the knowledge gained from SEED in my work with students. • I am able to put into practice the ideas presented in SEED. • SEED has improved student learning in my classroom. • SEED has provided me with knowledge and skills to support high-needs students.
Apply what has been learned from SEED in classroom (TF)	• On average, how often do you apply what you have learned in SEED in your classrooms?
SEED utility to support teacher PD (TF)	• SEED content is useful for my PD. • The SEED PD is relevant to my needs. • The integration of the SEED PAK and RANDA is easy to use. • The integration of the SEED PAK and RANDA allowed me to better track my professional growth plans. • The integration of the SEED PAK and RANDA helped facilitate conversations with my principal about professional growth.
Quality of IC support (TF)	• My IC provided information and resources I needed to support my learning needs and professional goals. • My IC was available to answer questions. • My IC was knowledgeable about PD topics. • Overall, I was satisfied with the quality of the coaching and support I received.
SEED impact on peer collaboration (TF)	• SEED has encouraged teachers to share what they learned with their colleagues. • My school provided opportunities for teachers to share information gained from SEED with colleagues. • Teachers in my school took advantage of opportunities to share ideas, knowledge, and skills gained from SEED. • SEED involved collaboration with teachers from other schools who teach at the same grade level and/or content area.
Principal engagement in teacher PD (TF)	• My principals or supervisor recommended and planned PD based on needs identified through the teacher evaluation process. • The current teacher evaluation systems in place provide information that allows my principal or supervisor to be supportive of teacher PD. • My principal or supervisor understands what PD support teachers need. • During conversations with my principal or supervisor regarding my professional growth (i.e., improvement on the teacher evaluation rubric and in knowledge and implementation of best practices), my principal is supportive.

Table A13 shows Cronbach's alphas for all teacher survey constructs over time. Overall, reliability estimates were high ($\alpha > 0.80$) across all scales except the growth mindset scale. Specifically, the reliability estimate of the growth mindset scale was low and below the acceptable level ($\alpha < 0.70$). In this final report, data on growth mindset were excluded due to consistent low internal reliability of the measure.

Table A13. Reliability Estimates of Teacher Survey Constructs Over Time

Subscales	Pilot Baseline (fall 2015)		Full Implementation									
			Baseline (spring 2016)		Y1 (spring 2017)		Y2 (spring 2018)		Y3 (spring 2019)		Y4 (spring 2020)	
	n	α	*n*	α	*n*	α	*n*	α	*n*	α	*n*	α
Teacher Perception of School Approach to PD												
Instructional practice-focused PD	59	0.96	293	0.97	273	0.97	368	0.97	404	0.96	280	0.97
Data-driven PD	58	0.88	291	0.91	271	0.91	365	0.89	404	0.88	284	0.91
School-provided time and resources to access PD[a]	59	0.84	292	0.88	275	0.88	374	0.87	408	0.85	286	0.90
Student learning-focused PD	60	0.81	296	0.91	277	0.94	377	0.93	407	0.92	287	0.96
Other Teacher Perception and Experience Measures												
Growth mindset	--	--	--	--	279	0.29	369	0.51	409	0.46	281	0.35
Quality of SEED PAK[b]	--	--	--	--	--	--	125	0.93	100	0.70	67	0.94
Quality of SEED blog[c]	--	--	--	--	--	--	99	0.94	56	0.94	39	0.94
Quality of SEED course[d]	--	--	--	--	--	--	--	--	109	0.95	71	0.95
SEED impact on teacher instruction and student learning	--	--	--	--	80	0.96	187	0.97	208	0.96	195	0.96
SEED utility to support teacher PD	--	--	--	--	177	0.92	239	0.93	159	0.88	138	830
Quality of IC support	--	--	--	--	102	0.95	131	0.96	148	0.95	144	0.95
SEED impact on peer collaboration	--	--	--	--	200	0.89	249	0.88	305	0.85	223	0.85
Principal engagement in teacher PD[c]	--	--	--	--	--	--	373	0.87	406	0.84	278	0.85

[a] The construct includes two items. Hence, α is the correlation between these two items.
[b] In fall 2017, a separate survey including three items assessing teacher perception of the quality of SEED PAK was sent to teachers to collect baseline data.
[c] New constructs added to the teacher follow-up survey in 2018.
[d] A new construct added to the teacher follow-up survey in 2019.
Note. Constructs measured by one item are not reported in this table.

Student Engagement Survey

Two different student engagement surveys were developed for students in 3rd to 5th grades (SES:3-5) and 6th to 10th grades (SES:6-10) in May 2016. The same surveys were administered again with students in May 2017. For the 3rd to 5th grade survey, 17 items measuring four constructs of student engagement were included: (1) teacher-supported engagement in individual student learning (4 items); (2) teacher-supported engagement in content learning (5 items); (3) positive attitude toward school (4 items), and (4) teacher support (4 items). Items measuring individual student learning and content learning were developed by McREL, and these items were rated on a 1 to 5 (*strongly disagree* to *strongly agree*) scale. Items measuring positive attitude toward school and teacher support were from the Seattle Social Development Project (Catalano et al., 2005; Hawkins & Catalano, 1990; Kusche & Greenberg, 1988). Response options were *yes* and *no*.

For the 6th to 10th grade survey, 22 items measuring five constructs of student engagement were included: (1) teacher-supported engagement in individual student learning (4 items); (2) teacher-supported engagement in content learning (5 items); (3) school engagement in math learning (4 items); (4) school engagement in English learning (4 items); and (5) engagement in academic success (5 items). Items measuring individual student learning and content learning were developed by McREL and were rated on a 1 to 7 (*completely disagree* to *completely agree*) scale. Items measuring school engagement in math and English learning were from the Student Engagement Questionnaire (Dornbusch & Steinberg, 1990). Items measuring homework engagement were rated on a 1 to 6 scale (*none, about 15 minutes, about 3 minutes, about an hour, about 2 or 3 hours, about 4 hours*). The remaining school engagement items were rated on a 1 to 5 scale (*never, seldom, fairly often, usually, always*). Items measuring engagement in academic success were adapted from (Landau, Oyserman, Keefer, & Smith, 2014), and these items were rated on a 1 to 7 (*strongly disagree* to *strongly agree*) scale.

All students between 3rd and 10th grade from SEED schools were invited to take the anonymous student engagement survey online annually between spring 2016 and spring 2020. Each survey took about 10–15 minutes to complete. The overall response rates by grade level over time are presented in Table A14.[31] The low response rate during the 2020 study survey may be attributed to the disruption caused by the 2020 COVID-19 pandemic. Also resulting from the pandemic, schools were closed in March and remained closed throughout the remainder of the school year. Therefore, in the 2020 survey, students were asked to give the rating based on their experience prior to the school closure. Due to the unique challenges during the COVID-19 when the 2020 student survey was administered, data collected in the 2020 school year may not be directly comparable to data collected in the prior years.

Table A14. Student Survey Response Rate by Grade Level

Grade Level	Response Rate				
	2016	2017	2018 [a]	2019 [b]	2020 [c]
3rd	91.0%	82.8%	72.4%	75.6%	16.7%
4th	93.7%	86.1%	79.6%	79.9%	33.2%
5th	90.6%	85.5%	92.7%	85.5%	31.6%
6th	87.2%	89.5%	70.9%	73.5%	37.2%
7th	71.9%	82.7%	78.0%	63.6%	46.8%
8th	39.6%	79.8%	71.8%	65.7%	40.1%
9th	66.2%	56.0%	73.2%	64.2%	23.8%
10th	52.5%	54.7%	62.5%	53.6%	27.6%
Total	**75.5%**	**77.3%**	**75.3%**	**70.3%**	**32.5%**

Note. Data source for student enrollment number: https://www.cde.state.co.us/cdereval/pupilcurrent.
[a] Students (n = 6) who did not provide school information were removed from this analysis.
[b] Students (n = 12) who did not provide school (n = 12) or grade (n = 1) information were removed from this analysis.
[c] Students (n = 6) who did not provide grade information were removed from this analysis

Table A15 shows the items by construct measured in SES:3-5 and SES:6-10.

[31] Data source for school enrollment number is school data from the Colorado Department of Education website (https://www.cde.state.co.us/cdereval/pupilcurrentschool).

Table A15. SES Survey Items by Construct by Grade Level

Constructs	Items
SES:3–4	
Teacher-supported engagement: individual student learning	• My teachers help me do my best work. • My teachers know how I like to learn. • My teachers know how to help me with my work. • My teachers give me different kinds of work to help me learn.
Teacher-supported engagement: content learning	• My teachers know a lot about what we are learning in class. • My teachers help the class understand what we are learning. • My teachers know the answers to questions I have about what we are learning. • My teachers help me when I don't know the answer. • I learn a lot from my teachers.
Positive attitude toward school	• Do you think school is fun? • Do nice things happen to you at school? • Do you feel unhappy at school a lot? • Do you look forward to going to school?
Teacher support	• Does your teacher notice when you try hard? • Does your teacher tell you when you do well? • Does your teacher help you when you need it? • Do you like your teacher?
SES:6–10	
Student engagement in math learning	• Homework: In the <current school year> school year, how much time have you put into math homework each week?[a] • Attendance: In the <current school year> school year, how often do you skip/miss your math class (an unexcused absence)?[b, c] • Classroom Attention: In the <current school year> school year, how often do you really pay attention during your math class?[b] • Classroom Concentration: In the <current school year> school year, how often does your mind wander during your math class?[b, c]
Student engagement in English/language arts learning	• Homework: In the <current school year> school year, how much time have you put into English/language arts homework each week, including reading and writing assignments?[a] • Attendance: In the <current school year> school year, how often do you skip/miss your English/language arts class (an unexcused absence)?[b, c] • Classroom Attention: In the <current school year> school year, how often do you really pay attention during your English/language arts class?[b] • Classroom Concentration: "In the <current school year> school year, how often does your mind wander during your English/language arts class?[b, c]
Teacher-supported engagement: individual student learning	• My teachers help me do my best work. • My teachers know how I like to learn. • My teachers know how to help me with my work. • My teachers give me different kinds of work to help me learn.
Teacher-supported engagement: content learning	• My teachers know a lot about what we are learning in class. • My teachers help the class understand what we are learning. • My teachers know the answers to questions I have about what we are learning. • My teachers help me when I don't know the answer. • I learn a lot from my teachers.

Constructs	Items
Engagement in academic success	• My academic success in the future begins now. • I have a hard time seeing myself as an academically successful student next year.[c] • My image of myself as an excellent student next year feels like a natural part of who I am now. • I feel connected to my image of myself as a successful student next year. • I can easily see myself being an academically successful student next year.

[a] Each item was rated on a 5-point Likert-type scale; the responses ranging from *strongly disagree* (1) to *strongly agree* (5).
[b] Each item was rated *yes* (2) or *no* (1).
[c] The item was reverse coded. A higher score means better outcome.

Table A16 shows Cronbach's alphas for all subscales throughout the full implementation period. The scales with a Cronbach's alpha lower than 0.70 are highlighted in orange in Table A16. The constructs that have acceptable internal consistency ($a >= 0.70$) between baseline and Y3 are (1) teacher-supported engagement in content learning for both 3rd–5th and 6th–10th graders; (2) teacher-supported engagement in individual student learning for 6th–10th graders; and (3) engagement in academic success for 6th–10th graders.

Table A16. Reliability Estimates of SES:3-5 and SES:6-10 Subscales

Subscales	Full Implementation									
	Baseline (spring 2016)		Y1 (spring 2017)		Y2 (spring 2018)		Y3 (spring 2019)		Y4 (spring 2020)	
	n	α	*n*	α	*n*	α	*n*	α	*n*	α
SES:3-5										
Teacher-supported engagement in individual student learning	1433	0.66	1311	0.72	1351	0.68	1322	0.75	419	0.80
Teacher-supported engagement in content learning	1409	0.75	1282	0.75	1321	0.72	1297	0.80	400	0.80
Positive attitude toward school[a]	1456	0.65	1323	0.65	1371	0.65	1345	0.70	425	0.64
Teacher support	1417	0.61	1289	0.65	1336	0.64	1315	0.64	414	0.55
SES:6-10										
Teacher-supported engagement in individual student learning	1687	0.84	1899	0.84	2025	0.86	1889	0.85	1015	0.58
Teacher-supported engagement in content learning	1661	0.91	1869	0.91	2019	0.92	1880	0.91	989	0.50
Student engagement in math[b]	1703	0.53	1916	0.53	2010	0.55	1871	0.53	977	0.84
Student engagement in English[b]	1671	0.50	1884	0.50	1995	0.52	1876	0.54	968	0.91
Engagement in academic success	1653	0.82	1862	0.83	2017	0.84	1864	0.84	950	0.86

[a] One item was worded negatively. The item was reverse-coded when calculating the scale reliability.

Subscales	Full Implementation									
	Baseline (spring 2016)		Y1 (spring 2017)		Y2 (spring 2018)		Y3 (spring 2019)		Y4 (spring 2020)	
	n	α	*n*	α	*n*	α	*n*	α	*n*	α

[b] All items were measured on a six-point scale, except that one item was measured on a seven-point scale. The item was rescaled to a six-point scale when calculating the reliability. Also, two items were worded negatively, and these two items were reverse-coded when calculating the scale reliability.

Project Record and Extant Data

Several project records and extant data were included in the evaluation, including

- IC syllabi and TLC materials
- Project staff self-reflection of implementation progress and challenges
- PD committee and content development meeting minutes[32]
- Teacher participation in SEED data (i.e., IC participation logs)
- Teacher participation in Content Development Teams data
- PD completion data
- SEED PAK resources
- Data related to linkage of SEED platform and COPMS (RANDA)
- TLC participation gradebook data
- COPMS data (teacher evaluation data)
- Individual-level student demographic data and achievement data in math and ELA for students from the participating schools
- School-level demographic data and student achievement data in math and ELA for students from comparison schools
- Other project implementation records maintained by the project team

These data were provided by the project staff, except student achievement data[33] that were provided by the Colorado Department of Education (CDE) and teacher COPMS data that were provided by RANDA Solutions. Publicly available data released by CDE were also used in the evaluation as appropriate. For instance, the following CDE websites were frequently used to access school demographic and school-level student achievement data:

- https://www.cde.state.co.us/cdereval/staffcurrent
- http://www.cde.state.co.us/cdereval/rvprioryearpmdata
- https://www.cde.state.co.us/cdereval/rvprioryearhrdata
- https://www.cde.state.co.us/cdereval/pupilcurrent
- http://www.cde.state.co.us/code/accountability-dataexplorertool

[32] These were formal meeting minutes that were taken to document the agenda items, decisions made around them, and any other action items.

[33] A data-sharing agreement (DSA) between McREL and CDE was established to access student achievement data for the evaluation. The DSA allows McREL to access student-level achievement data for all SEED schools and school-level achievement data for the selected matched comparison schools.

Due to the 2020 COVID-19 pandemic, student achievement data and teacher evaluation data were not available for the 2019–20 school year.

Data Analysis Plan

All evaluation data collected were reviewed and cleaned prior to any analyses. Data cleaning consisted of reviewing all project records and surveys and identifying information gaps, discrepancies, and redundancies. Instances in need of clarification or further cleaning were managed on a case-by-case basis. Before quantitative data analyses were performed, evaluators screened the data for data entry errors and improbable responses. Descriptive statistics (e.g., frequencies, percentages, means, standard deviations, or cross-tabulations) were examined for all quantitative data collected, including principal, teacher, student surveys as well as COPMS (RANDA) data and student achievement data.

This section is organized into four sub-sections. The first discusses the process to determine baseline data for different survey data sources. The second discusses the approach to convert reading and math scale scores to z-scores. The third presents the data analysis plan and strategies for each evaluation question. The last section describes the method to calculate and report on effect size (ES).

Baseline Data

Because the project design involves three phases—development (spring 2015), pilot (2015–16), and full implementation (2016–17 through 2019–20)—baseline data were collected on different timelines depending on the outcomes of interest and data sources. Overall, for the principal survey, data collected during the pilot (2015–16) were used as baseline since all principals and assistant principals started participating in SEED at the start of the pilot. For the student engagement survey and student achievement data, data collected in spring 2016 were used as baseline since the full implementation started in 2016–17 school year. The baseline timeline for the teacher survey data was more complicated because only a subgroup of teachers participated in SEED during the pilot. Additionally, as the project continued to progress and mature, additional data of interest were collected after the pilot (see Data Collection Methods section for details).

Preliminary analyses were conducted to determine the baseline data for the teacher survey. Pilot teachers' and non-pilot teachers' baseline data were collected at different time points (pilot teachers' baseline data were collected in fall 2015 while non-pilot teachers' baseline data were collected in spring/summer 2016). Group differences between pilot teachers' and non-pilot teachers' perceptions and experiences at baseline were examined. Specifically, a series of multilevel models was estimated to account for the nested nature of the datasets (i.e., teachers nested within schools). Results indicated that pilot teachers and non-pilot teachers did not differ in the following constructs at baseline (i.e., before exposure to SEED):

- Instructional practice-focused PD ($\beta = 0.26$, $SE = 0.14$, $p = 0.061$)
- Data-driven PD ($\beta = -0.80$, $SE = 0.15$, $p = 0.590$)
- School-provided time and resources to access PD ($\beta = -0.04$, $SE = 0.17$, $p = 0.984$)
- Student learning-focused PD ($\beta = 0.09$, $SE = 0.13$, $p = 0.516$)
- Opportunity to collaborate ($\beta = 0.11$, $SE = 0.16$, $p = 0.474$)
- Up-to-date PD ($\beta = 0.18$, $SE = 0.218$, $p = 0.218$)
- Evidence-based PD ($\beta = 0.08$, $SE = 0.15$, $p = 0.579$)

These findings suggest that it is appropriate to combine pilot teachers' and non-pilot teachers' baseline data. Analyses were conducted to examine if teachers' perceptions on these constructs changed over time. A series of multilevel models (i.e., repeated measures nested within individuals, and individual nested within schools) was conducted to account for the nested data structure. Hedge's *g* was calculated to show the magnitude of change between baseline and the end of Year 1 full implementation.

In terms of the follow-up measures, pilot teachers' experiences with SEED were first assessed in 2016 after one year of SEED participation, and the same data were collected again in 2017 after two years of SEED participation. For non-pilot teachers, their experiences with SEED were first examined in 2017 after one year of SEED participation. A total of 27 pilot teachers responded to both 2016 and 2017 surveys; paired-sample t-tests were conducted to examine changes in these pilot teachers' experiences with SEED. Results showed that these pilot teachers' experience with SEED did not change in the following constructs from 2016 to 2017.

- SEED impact on teacher instruction and student learning ($t = 1.96$, $df = 10$, $p = 0.079$)
- Apply what has been learned from SEED in classroom ($t = 0.80$, $df = 11$, $p = 0.438$)
- SEED content utility and PD relevance ($t = 2.15$, $df = 11$, $p = 0.054$)
- SEED PAK and RANDA utility to support teacher PD ($t = 1.09$, $df = 18$, $p = 0.290$)
- Quality of IC support ($t = 1.00$, $df = 13$, $p = 0.336$)
- SEED impact on peer collaboration practices ($t = 0.99$, $df = 22$, $p = 0.332$)

A series of multilevel models was also conducted to examine the differences between pilot teachers and non-pilot teachers regarding their SEED experiences measured in 2017. Results showed that pilot and non-pilot teachers' experiences with SEED did not significantly differ in the following constructs.

- SEED impact on teacher instruction and student learning ($\beta = -0.08$, $SE = 0.23$, $p = 0.721$)
- Apply what has been learned from SEED in classroom ($\beta = -0.23$, $SE = 0.26$, $p = 0.382$)
- SEED content utility and PD relevance ($\beta = -0.05$, $SE = 0.23$, $p = 0.825$)
- SEED PAK and RANDA utility to support teacher PD ($\beta = 0.11$, $SE = 0.27$, $p = 0.693$)
- Quality of IC support ($\beta = 0.17$, $SE = 0.20$, $p = 0.386$)
- SEED impact on peer collaboration practices ($\beta = 0.22$ $SE = 0.23$, $p = 0.350$)

It should be noted that pilot teachers were only exposed to a semester-long TLC during the pilot, so it is not totally unexpected to find that their responses about their experiences with SEED in spring 2017 were not significantly different from those who started participating in SEED in the 2016–17 school year. Hence, the spring 2017 data collected from all teachers, including pilot teachers, were analyzed and reported as the Y1 follow-up data.

Converting Scale Scores to Z-scores

Student achievement data were obtained from the CDE website. Between 2016 (baseline) and 2019 (Y3 outcome), student achievement data that were available from CDE and used in the analyses include:[34]

- Partnership for Assessment of Readiness for College and Careers (PARCC) ELA and math tests scores for students from third to eighth grade for the 2015–16 and 2016–17 school years
- Colorado Measures of Academic Success (CMAS) ELA and math tests scores for students from third to eighth grade for the 2017–18 and 2018–19 school years
- Preliminary SAT (PSAT) ELA and math test scores for students in 10th grade

The CDE website provides within-grade school mean scores for all students as well as student subgroups. To allow for cross-grade level comparisons, the within-grade school mean scores were converted to z-scores using the state means and standard deviations calculated from individual student-level data within grade within the test year. The formula for converting scale scores to z-scores is

$$Z_{iGj} = (Y_{iGj} - StateMeanStudents_{iG}) / StateSDStudents_{iG}$$

where

Z_{iGj} = the z-score from the i^{th} time point in the G^{th} grade in the j^{th} school

Yi_{Gj} = the observed reading school-mean reading score from the i^{th} time point in the G^{th} grade in the j^{th} school;

$StateMeanStudents_{iG}$ = the population mean of reading scores of all students in the state at the i^{th} time point in the G^{th} grade

$StateSDStudents_{iG}$ = the population standard deviation of reading scores of all students in the state at the i^{th} time point in the G^{th} grade.

After z-scores were calculated, a school-level mean ELA score and a school-level mean math score were calculated for each school. Student achievement data collected during the 2015–16 school year were used as the baseline data for the matching. The 2016–17, 2017–18, and 2018–19 data were

[34] In 2018, CDE transitioned the state standardized tests from PARCC to CMAS. Therefore, the baseline data (2015–16) and the Y1 student achievement outcome (2016–17) for the impact analyses were measured by PARCC. Starting with the 2017–18 school year (Y2 outcome), student outcomes were measured by CMAS. According to the technical report released by CDE, the correlations between PARCC scales and CMAS scales were greater than 0.98 in math and greater than 0.97 in ELA. The high correlations between the baseline tests and the Y2–3 outcome measures meet the minimal requirement specified by the WWC standards—correlation between the baseline measurement and outcome measurements should be 0.60 or higher. Additionally, starting in the 2017–18 school year, CMAS was no longer administered to 9th-grade students in the State of Colorado. To allow for longitudinal comparison, this report only included the CMAS data collected from 3rd to 8th-grade students during the project period.

used as the Y1, Y2, and Y3 outcome measures, respectively. The same procedure was applied to all six independent QED studies with corresponding data from student groups.

Data Analysis Strategies by Evaluation Questions

Data analysis strategies used to answer each evaluation question are summarized in Table A17. The outcomes of interest for each question are also specified in the table. Items used to measure the constructs (outcomes of interest) are provided in Tables A9 (principal-reported outcome measures), A12 (teacher-reported outcome measures), and A13 (student-reported outcome measures).

Table A17. Outcomes of Interest and Data Analysis Strategies by Evaluation Question

Evaluation Question	Outcomes of Interest	Data Analysis Plan
Goal 1. Successfully implement and continually improve SEED in up to 30 NW BOCES schools during a four-year period (timeliness and continuous improvement)		
a. Are project activities occurring as planned?	Fidelity of implementation; implementation challenges; implementation successes	Project record review and content analysis; descriptive analysis of SEED participation data. Data collected throughout the project period were included in the analyses.
b. Is the project maintaining its planned rigor?		
c. What barriers and unanticipated outcomes were encountered, and what revisions were made during implementation?		
d. What were key project successes during implementation?		
Goal 2. Improve principal engagement in teacher professional growth and support.		
a. Are principals more engaged in teacher professional growth?	Principal engagement in teacher PD	***Latent growth curve modeling (LGC).*** Individual responses (i.e., principal and teacher responses) were aggregated to the school level and used in the analysis. LGC was conducted to examine the rate of change over time.
b. Are principals able to provide more and better support to teachers through SEED?	SEED utility to support teacher PD	
c. Do SEED teachers, in comparison with non-SEED teachers, report a higher level of principal engagement in teacher professional growth?*	Principal engagement in teacher PD	***Hierarchical linear modeling (HLM).*** Individual responses (i.e., teacher responses) were used in the analysis. Multilevel modeling was conducted to examine the difference between SEED and non-SEED teachers while accounting for the nested structure of the data. Data collected during the 2018–19 school year were used in the analyses. Regardless of the SEED participation status in the 2018–19 school year, teachers might have prior exposure to SEED before then. Therefore, teachers' prior participation data during the 2016–17 and 2017–18

Evaluation Question	Outcomes of Interest	Data Analysis Plan
		school years were used to determine their prior experience with SEED.[35]
d. What is the relationship between school-level SEED participation rates and principal and teacher reports of principal engagement in teacher PD?*	Principal engagement in teacher PD	***Regression analysis.*** Level of SEED implementation was measured by the percentage of teachers who were defined as SEED participants within each school. Data collected from 2018–19 were used for the analysis (Y3 full implementation). A series of linear regression analyses was conducted to understand the associations between levels of SEED participation and the outcomes of interest.[36]
Goal 3. Increase rural teachers' access to and use of current best practices and up-to-date content knowledge.		
a. Are teachers utilizing SEED? Which activities are teachers using? Does use increase over time?	SEED participation in various SEED activities	Descriptive analysis of SEED utilization, SEED participation, COPMS and IC participation data. Data collected throughout the project period were used in the analyses.
b. Is PD reflective of best practices and up-to-date content knowledge?	• Up-to-date PD • Evidence-based PD • School offering evidence-based PD	***LGC.*** Individual responses (i.e., principal and teacher responses) were aggregated to the school level and used in the analysis. LGC was conducted to examine the rate of change over time.
c. Do teachers have time and resources to access PD?	• School-offered time and resources to access PD	
d. Is PD offered to teachers driven by data and does it meet the needs of individual teachers?	• Data-driven PD • School-offered individualized teacher PD	
e. Do SEED teachers, in comparison with non-SEED teachers, give higher ratings regarding the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is data-driven and aligned with individual needs; and (3) teachers have time and resources to access PD?*	• Up-to-date PD • Evidence-based PD • Data-driven PD • School-offered individualized teacher PD • School-offered time and resources to access PD	***HLM.*** Individual responses (i.e., teacher responses) were used in the analysis. Multilevel modeling was conducted to examine the difference between SEED and non-SEED teachers while accounting for the nested structure of the data. Data collected during the 2018–19 school year were used in the analyses. Regardless of the SEED participation status in the 2018–19 school year, teachers might have prior exposure to

[35] A variable indicating teachers' prior experience with SEED was created and entered in the final analytic model as a covariate (0 = never participated in SEED; 1 = had 1 year of experience with SEED prior to 2018–19; 2 = had 2 years of experience with SEED prior to 2018–19).

[36] Baseline data were entered in the regression models as a covariate. Specifically, 2016 data were used as baseline data for the teacher survey, teacher evaluation data, and student survey data; 2015 data were used as baseline for principal survey data.

Evaluation Question	Outcomes of Interest	Data Analysis Plan
		SEED before then. Therefore, teachers' prior participation data during the 2016–17 and 2017–18 school years were used to determine their prior experience with SEED.[37]
f. What is the relationship between school-level SEED participation rates and teachers' ratings on the extent to which (1) PD is reflective of best practice and up-to date content knowledge; (2) PD offered is data-driven and aligned with individual needs; and (3) teachers have time and resources to access PD?*	• Up-to-date PD • Evidence-based PD • Data-driven PD • School-offered individualized teacher PD • School-offered time and resources to access PD	***Regression analysis.*** Level of SEED implementation was measured by the percentage of teachers who were defined as SEED participants within each school. Data collected from 2018–19 were used for the analysis (Y3 full implementation). A series of linear regression analyses was conducted to understand the associations between levels of SEED participation and the outcomes of interest.[38]
Goal 4. Support teachers in successfully implementing SEED practices and content.		
a. Does teachers' knowledge of best practices increase?	• Instructional practice-focused PD • Student learning-focused PD	***LGC.*** Individual responses (i.e., teacher responses) were aggregated to the school level and used in the analysis. LGC was conducted to examine the rate of change over time.
b. Do teachers demonstrate practice change in the classroom?	SEED teachers only: • SEED impact on teacher instruction and student learning • Teachers applied what they learned from SEED in classroom • SEED impact on peer collaboration All teachers: • Opportunity to collaborate • Teacher evaluation ratings	
c. Do SEED teachers, in comparison with non-SEED teachers, (1) give higher ratings on their knowledge of best practices, (2) have more opportunity to collaborate with	• Instructional practice-focused PD • Student learning-focused PD • Opportunity to collaborate • Teacher evaluation ratings	***HLM.*** Individual responses (i.e., teacher responses) were used in the analysis. Multilevel modeling was conducted to examine the difference between SEED and non-SEED teachers while accounting for the

[37] A variable indicating teachers' prior experience with SEED was created and entered in the final analytic model as a covariate (0 = never participated in SEED; 1 = had 1 year of experience with SEED prior to 2018–19; 2 = had 2 years of experience with SEED prior to 2018–19).

[38] Baseline data were entered in the regression models as a covariate. Specifically, 2016 data were used as baseline data for the teacher survey, teacher evaluation data, and student survey data; 2015 data were used as baseline for principal survey data.

Evaluation Question	Outcomes of Interest	Data Analysis Plan
job-alike peers, and (3) have higher teacher evaluation scores?*		nested structure of the data. Data collected during the 2018–19 school year were used in the analyses. Regardless of the SEED participation status in the 2018–19 school year, teachers might have prior exposure to SEED before then. Therefore, teachers' prior participation data during the 2016–17 and 2017–18 school years were used to determine their prior experience with SEED.[39]
d. What is the relationship between school-level SEED participation rates and (1) teachers' ratings on their knowledge of best practices, (2) teachers' opportunity to collaborate with job-alike peers, and (3) teacher evaluation scores?*	• Instructional practice-focused PD • Student learning-focused PD • Opportunity to collaborate • Teacher evaluation ratings	***Regression analysis.*** Level of SEED implementation was measured by the percentage of teachers who were defined as SEED participants within each school. Data collected from 2018–19 were used for the analysis (Y3 full implementation). A series of linear regression analyses was conducted to understand the associations between levels of SEED participation and the outcomes of interest.[40]
Goal 5. Improve student achievement.		
a. To what extent do SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation?	• School-level reading outcome • School-level math outcome	***Regression analysis.*** A series of linear regression analyses was conducted to understand the difference between SEED and non-SEED schools at the end of Year 1, Year 2, and Year 3. All covariates used in the matching process were included in the final analytical model (see the impact analytic model following this table). Data collected between the 2015–16 and 2018–19 school years were included in the analysis. See the impact analytic model following this table.
b. To what extent do students from SEED schools demonstrate an increase in student achievement outcomes over time?*	• School-level reading outcome • School-level math outcome	***LGC.*** School-level student achievement data were used in the analysis. Conditional LGC was conducted to examine the rate of

[39] A variable indicating teachers' prior experience with SEED was created and entered in the final analytic model as a covariate (0 = never participated in SEED; 1 = had 1 year of experience with SEED prior to 2018-19; 2 = had 2 years of experience with SEED prior to 2018-19).

[40] Baseline data were entered in the regression models as a covariate. Specifically, 2016 data were used as baseline data for the teacher survey, teacher evaluation data, and student survey data; 2015 data were used as baseline for principal survey data.

Evaluation Question	Outcomes of Interest	Data Analysis Plan
		change over time while controlling for other school-level covariates. Data collected between the 2015–16 and 2018–19 school years were included in the analysis.
c. To what extent do high-needs students from SEED schools and comparison schools differ in student achievement outcomes after one year, two years, and three years of full implementation?	• School-level reading outcome of high-needs students • School-level math outcome of high-needs students	***Regression analysis.*** A series of linear regression analyses was conducted to understand the difference between high-needs students within SEED and those within non-SEED schools at the end of Year 1, Year 2, and Year 3. High-needs students include students from racial/ethnic minority backgrounds and students receiving free or reduced lunch. All covariates used in the matching process were included in the final analytical model. Data collected between 2015–16 and 2018–19 school years were included in the analysis. See the impact analytic model following this table.
d. To what extent do high-needs students from SEED schools demonstrate an increase in student achievement outcomes over time?*	• School-level reading outcome of high-needs students • School-level math outcome of high-needs students	***LGC.*** School-level high-needs student achievement data were used in the analysis. Conditional LGC was conducted to examine the rate of change over time while controlling for school-level covariates. High-needs students include students from racial/ethnic minority backgrounds and students receiving free or reduced-price lunch. Data collected between the 2015–16 and 2018–19 school years were included in the analysis.
e. Do schools with higher levels of teacher participation have higher student achievement?*	• School-level reading outcome • School-level math outcome	***Regression analysis.*** Level of SEED implementation was measured by the percentage of teachers who were defined as SEED participants within each school. Data collected from 2018–19 were used for the analysis (Y3 full implementation). A series of linear regression analyses was conducted to understand the associations between levels of SEED

Evaluation Question	Outcomes of Interest	Data Analysis Plan
		participation and the outcomes of interest.[41]
Goal 6. Improve student engagement.		
a. Does student engagement increase among participating schools?	• **For G3–5:** Teacher-supported engagement: individual student learning; teacher-supported engagement: content learning; positive attitude toward school; and teacher support • **For G6–10:** Student engagement in math learning; student engagement in ELA learning; teacher-supported engagement: individual student learning; teacher-supported engagement: content learning; and engagement in academic success	***LGC.*** Individual responses (i.e., principal and teacher responses) were aggregated to the school level and used in the analysis. LGC was conducted to examine the rate of change over time. Data collected between the 2016–17 and 2018–19 were included in the analysis.[42]
b. Do schools with higher levels of teacher participation have higher levels of student engagement?*		***Regression analysis.*** Level of SEED implementation was measured by the percentage of teachers who were defined as SEED participants within each school. Data collected from 2018–19 were used for the analysis (Y3 full implementation). A series of linear regression analyses was conducted to understand the associations between levels of SEED participation and the outcomes of interest.

Note. Due to the 2020 COVID-19 pandemic, student achievement and teacher evaluation data were not available for the 2019–20 school year. For the same reason, during the 2019–20 school year, the survey response rates from principals, teachers, and students were much lower than the response rates in the prior years (see Tables A8, A11, and A14). Therefore, data collected during the 2019–20 school year were excluded from the analysis.

SEED Participants. Within SEED Schools, teachers were able to participate in SEED in various ways, from taking formal SEED courses to reading a SEED blog or complete a SEED PAK resource. Of various types of SEED activities, certain types of activities were more likely to make an impact on teacher practices and outcomes, including

- SEED course participant (individual who participated in at least 80% of the TLC, PPS, independent study, and book study)
- SEED PAK participant (individual who completed at least eight SEED PAK resources within a school year)
- SEED actor (individual who reported applying what he/she has learned from SEED in the classroom on a *weekly* or *daily* basis)
- SEED facilitator (individual who served as a SEED facilitator)

When comparing the difference between SEED teachers and non-SEED teachers (i.e., evaluation questions that compare the difference between SEED and non-SEED teachers), teachers who met

[41] Baseline data were entered in the regression models as a covariate. Specifically, 2016 data were used as baseline data for the teacher survey, teacher evaluation data, and student survey data; 2015 data were used as baseline for principal survey data.

[42] Due to the interruption caused by the COVID-19 pandemic, the survey response rate was low in the 2019–20 school year. Therefore, the 2019–20 student engagement data were excluded from the analysis.

at least one of the above criteria were identified as SEED teachers. Teachers who did not meet any of the above criteria were identified as non-SEED teachers.

Level of SEED Participation. School-level SEED participation rates were calculated based on teacher participation data collected in Y3 (2018–19). Schools with 50% or more of teachers who participated in SEED (as defined above) were coded as high participation (HP) schools, and schools with less than 50% of teachers participated in SEED were coded as low participation (LP) schools. For this part of the analyses, teachers who participated in SEED during the 2018–19 school year were included in the analysis. In 2019, the overall teacher participation rate across SEED schools ranged from 15% to 92%. Across all SEED schools (n = 20), eight (40%) were HP schools. A series of regression analyses was conducted to examine if principal perception of teacher PD, teacher perception of PD, teacher evaluation scores, and student engagement differ between HP and LP schools.

Analytic Models of Impact Studies. Six impact studies were conducted to examine the impact of SEED on student achievement, including three groups of students (all students within SEED schools, minority students, and FRL students) on two subject areas (reading and math). For each impact study, six sub-questions were examined:

- To what extent do SEED schools and comparison schools differ in reading outcomes after one year of full implementation?
- To what extent do SEED schools and comparison schools differ in reading outcomes after two years of full implementation?
- To what extent do SEED schools and comparison schools differ in reading outcomes after three years of full implementation?
- To what extent do SEED schools and comparison schools differ in math outcomes after one year of full implementation?
- To what extent do SEED schools and comparison schools differ in math outcomes after two years of full implementation?
- To what extent do SEED schools and comparison schools differ in math outcomes after three years of full implementation?

Within each impact study sample, a series of linear regression models was conducted. School-level student achievement data were used in the analyses; hence, the regression model was a one-level model. When conducing the analyses, all covariates used in the matching were entered in the first block, and treatment status (i.e., SEED variable) was entered in the second block. R^2 and changes in R^2 after entering the treatment status in the model were both reported. The simplified analytical model for the impact analyses is presented below.

$$Y = \beta_0 + \beta_{1\text{-}x}(Covariates) + \beta_{x+1}(SEED) + e$$

Where

Y = the standardized mean score in math or language arts

Covariates = the baseline school-level covariates[43] used in the matching

SEED = school treatment status (1 = SEED, 0 = comparison)

[43] The list of covariates used in the matching are described in the Study Samples section (see Tables A4 and A5).

β_{1-x}	= the effect of school level covariates
β_{x+1}	= the treatment effect
e	= the error term

Effect Size Calculation

This report follows What Works Clearinghouse reporting guidelines when calculating effect sizes for impact studies (What Works Clearinghouse, 2017). Specifically, because the outcomes were converted to z-scores, the mean difference between the groups is the effect size. According to Wolf (1986), an ES value of 0.25 or greater is educationally significant, and an ES value of 0.50 is of practical significance.

Appendix B. Assessment of Fidelity of Implementation

Table B1. SEED Fidelity of Implementation Matrix

Note. Unless otherwise noted, when a score was assigned based on percent: 1= low (0–33%); 2 = med (34–66%); 3 = high (67–100%).

Indicators	Definition	Unit of implementation	Data Source(s)	Data Collection (who, when)	Score for levels of implementation at unit level	Threshold for adequate implementation at unit level	Roll-up to next higher level if needed (score and threshold): Indicate level	Roll-up to program level (score and threshold for adequate implementation at sample level)	Expected sample for fidelity measure	Expected years of fidelity measurement	Score	
1. Topics for learning strands for PD are selected based on teacher needs	Learning strands chosen based on teacher need	Program	PD committee and content development team (CDT) meeting minutes	By June, meeting minutes put on Google Drive	Percent of learning strands that meet criteria. Score based on percent: (1) low; (2) med; (3) high.	3	N/A	Percent of learning strands that meet criteria. Score based on percent: (1) low; (2) med; (3) high. Threshold=3.	Program	Years 1–4 (2016–2020)	T1	3 (3/3 = 100%)
											T2	3 (2/2 = 100%)
											T3	3 (2/2 = 100%)
											T4	3 (2/2 = 100%)
2. Evidence-based PD is selected by ICs and CDTs for inclusion in the SEED PAK	PD activity has theoretical evidence base behind it	PD activity	SEED PAK resources reviewed to determine whether it contains strategies that are supported by research-based theory	By Sept., McREL reviews PD against research-based theory	Score assigned to each activity: 0 = no indication of theoretical base; and 1 = identified theoretical base	1	% of 20 randomly selected SEED PAK resources with score of 1. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3	% of 20 randomly selected SEED PAK resources with score of 1. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3	SEED PAK resources throughout the project	Years 1–4 (2016–2020)	T1	3 (16/20 = 80%)
											T2	3 (20/20 = 100%)
											T3	3 (18/20 = 90%)
											T4	3 (16/20 = 80%)
3. ICs and CDTs create in-person TLC activities	TLCs include at least two in-person	Program	ICs' syllabi for the TLCs	By Sept. and Feb., SEED TLC syllabus	Percent of TLCs that include at least 2 in-person activities per	3	N/A	Percent of TLCs that include at least 2 in-person activities per	Program	Years 1–4 (2016–2020)	T1	3 (6/6 = 100%)
											T2	3

	activities per semester			put on Google Drive	semester. Score based on percent: (1) low; (2) med; (3) high.			semester. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3				(5/5 = 100%)
											T3	3 (3/3 = 100%)
											T4	3 (3/3 = 100%)
4. ICs and CDTs create virtual TLC activities	TLCs that have at least one hour per week of virtual activities	Program	ICs' syllabi for the TLCs	By Sept. and Feb., TLC syllabus posted on Google Drive	Percent of TLCs that have a least one hour per week of virtual activities. Score based on percent: (1) low; (2) med; (3) high.	3	N/A	Percent of TLCs that have a least one hour per week of virtual activities. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3	TLCs	Years 1–4 (2016–2020)	T1	3 (6/6 = 100%)
											T2	3 (5/5 = 100%)
											T3	3 (3/3 = 100%)
											T4	3 (3/3 = 100%)
5. ICs format TLC delivery using evidence-based delivery standards	TLCs utilize the four evidence-based TLC standards from Vescio et al. (2008) model.	Program	TLC reviewed against Vescio et al. (2008) TLC standards	Feb and Sep., McREL reviews each TLC's syllabus put on the Google drive	Percent of TLCs that utilize the four evidence-based TLC standards. Score based on percent: (1) low; (2) med; (3) high.	3	N/A	Percent of TLCs that utilize the four evidence-based TLC standards. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3.	Program	Years 1–4 (2016–2020)	T1	3 (6/6 = 100%)
											T2	3 (5/5 = 100%)
											T3	3 (3/3 = 100%)
											T4	3 (3/3 = 100%)
Total Score for SEED PD Creation Component								**Mean of the five indicators. Threshold=3.**			**T1**	**3**
											T2	**3**
											T3	**3**
											T4	**3**
6. ICs facilitate blended learning TLCs	TLC is hosted for each learning strand	Program	ICs syllabi for TLCs and content development team meeting minutes determining learning strands	By Aug. and Jan., documents are put on Google Drive	Percent of learning strands that have TLCs hosted as indicated in syllabi. Score based on percent: (1) low; (2) med; (3) high.	3	N/A	Percent of learning strands that have TLCs hosted as indicated in syllabi. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3.	Program	Years 1–4 (2016–2020)	T1	3 (6/6 = 100%)
											T2	3 (5/5 = 100%)
											T3	3 (3/3 = 100%)
											T4	3 (3/3 = 100%)

Total Score for SEED PD Delivery Component								**Same as indicator 6. Threshold=3.**			**T1** **T2** **T3** **T4**	**3** **3** **3** **3**
7. SEED PD is linked to specific teacher performance indicators by teachers or principals[44]	Principal or teacher assigns at least one SEED PD in COPMS	Teachers	SEED system linking COPMS with SEED platform	By June, SEED COPMS data will be provided to McREL	0 = No 1 = Yes	1	School level: % of teachers with score of 1 in each school. Score based on percent: (1) low (0–19%); (2) med (20–50%); (3) high (51–100%). Threshold = 2	Percent of schools that have score of 2. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3.	All schools in which the intervention is being implemented	Years 1–4 (2016–2020)	T1 T2 T3 T4	1 (0/21 = 0%)[45] 1 (7/21 = 33%)[46] 2 (7/20 = 35%)[47] 1 (2/20 = 10%)[48]
8. Teachers complete SEED PD[49]	Teacher completes at least one facilitated SEED PD **OR** self-directed completion	Teachers	SEED platform PD completion data and Innovation Coach TLC gradebook data and	By June, SEED platform data will be provided to McREL and by January	0 = No 1 = Yes	1	School level: % of teachers with score of 1 in each school. Score based	Percent of schools that have score of 2. Score based on percent: (1) low; (2) med; (3) high. Threshold = 3.	All schools in which the intervention is being implemented	Years 1–4 (2016–2020)	T1 T2	1[50] (6/21 = 29%) 2[51] (9/21 = 43%)

[44] This indicator is measured by the number of teachers who were assigned, self-assigned, or assigned by others, at least one SEED PAK resource during the school year.
[45] Within SEED schools, the percentage of teachers who were assigned at least one SEEK PAK resource during the school year ranged from 0 to 17%. None of the SEED schools had a score of 2.
[46] Within SEED schools, the percentage of teachers who were assigned at least one SEED PAK resource during the school year ranged from 0 to 88%. Seven out of 21 schools had a score of 2.
[47] Within SEED schools, the percentage of teachers who were assigned at least one SEED PAK resource during the school year ranged from 0 to 75%. Seven out of 20 schools had a score of 2.
[48] Within SEED schools, the percentage of teachers who were assigned at least one SEED PAK resource during the school year ranged from 0 to 28%. Two out of 20 schools had a score of 2.
[49] SEED PD included SEED PD offerings (i.e., TLCs, PPS, SEED PAK independent study, book study, and others [i.e., Alt-licensure, induction, EL modules, SEED facilitator]) and SEED PAK (i.e., complete at least 8 resources within one school year).
[50] Within SEED schools, the percentage of teachers who completed SEED PD ranged from 0 to 63% across SEED schools. Six out of 21 schools had a score of 2.
[51] Within SEED schools, the percentage of teachers who completed SEED PD ranged from 6 to 48% across SEED schools. Nine out of 21 schools had a score of 2.

	of at least 8 SEED PAK activities per academic year		other facilitated use (participation score must be at least 80% to be "complete")	and June, IC "gradebook" and facilitated use data will be uploaded on Google Drive.			on percent: (1) low (0–19%); (2) med (20–50%); (3) high (51–100%). Threshold = 2				T3	3[52] (14/20 = 70%)
											T4	3[53] (15/20 = 75%)
Total Score for SEED Participation Component								**Mean of the two indicators. Threshold = 3.**			**T1**	**1**
											T2	**1.5**
											T3	**2.5**
											T4	**2**

[52] Within SEED schools, the percentage of teachers who completed SEED PD ranged from 10 to 69% across SEED schools. Fourteen out of 20 schools had a score of 2.
[53] Within SEED schools, the percentage of teachers who completed SEED PD ranged from 13 to 100% across SEED schools. Fifteen out of 20 schools had a score of 2.

Appendix C. Baseline Equivalence and Impact Analysis Outputs and Results

This appendix shows the statistical outputs from the impact analyses across all six study samples. Weights generated from MatchIt were applied in all analyses including the analyses for baseline equivalence. Because all outcomes were z-scored, the coefficient was the effect size—the magnitude of the difference between SEED and non-SEED schools on the outcomes of interest. Table C1 shows the statistical outputs of linear regression models for the impact analyses—Goals 5a and 5c. Positive findings are highlighted in green. Table C2 provides the sample sizes, adjusted and unadjusted group means, and unadjusted standard deviations on outcome measures. Because the study samples changed slightly due to missing data in Years 1, 2, and 3, the state of baseline equivalence for the Year 1, 2, and 3 study samples are provided in Tables C3, C4, and C5, respectively.

Table C1. Statistical Outputs of the Impact Analysis

#	Sample	Y1 Outcome			Y2 Outcome			Y3 Outcome		
		β	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*
1	**All Students with ELA Outcome**									
	SmallSch	0.09	0.04	0.025	0.02	0.05	0.706	0.07	0.05	0.179
	MID	0.11	0.05	0.034	0.11	0.06	0.093	0.08	0.07	0.225
	HIGH	0.02	0.05	0.664	0.03	0.06	0.633	-0.06	0.06	0.324
	ELMMID	0.14	0.06	0.011	0.11	0.07	0.113	0.05	0.07	0.515
	MIDHIGH	0.04	0.05	0.408	0.01	0.06	0.864	-0.03	0.07	0.656
	K12	0.18	0.09	0.046	0.04	0.11	0.735	0.15	0.11	0.202
	Remote	-0.07	0.05	0.196	0.09	0.06	0.183	0.04	0.07	0.596
	MinorityGP	-0.04	0.05	0.511	-0.04	0.06	0.567	-0.04	0.07	0.535
	FRLGP1	-0.01	0.05	0.914	-0.03	0.06	0.656	-0.12	0.07	0.079
	FRLGP2	-0.09	0.06	0.170	-0.04	0.08	0.558	-0.05	0.08	0.522
	ELGP1	-0.10	0.04	0.017	-0.09	0.05	0.079	-0.02	0.05	0.658
	ELGP2	-0.15	0.10	0.133	-0.07	0.12	0.529	0.03	0.14	0.831
	ELA_0	0.74	0.05	0.000	0.70	0.06	0.000	0.56	0.07	0.000
	SEEDSch	0.04	0.04	0.263	0.06	0.05	0.197	0.10	0.05	0.052
	R^2 Change			0.003			0.006			0.02
2	**Minority Students with ELA Outcome**[54]									
	SmallSch	-0.02	0.06	0.704	-0.17	0.07	0.032	-0.23	0.08	0.007
	BuildingGP	0.13	0.05	0.012	-0.05	0.06	0.447	-0.06	0.07	0.375
	FRLGP	0.12	0.07	0.089	0.00	0.09	0.959	0.12	0.10	0.207
	MinorityGP	-0.02	0.09	0.853	-0.22	0.10	0.042	-0.16	0.11	0.160
	ELGP	-0.13	0.06	0.024	-0.05	0.07	0.454	0.05	0.07	0.516
	ELA0	0.45	0.12	0.001	0.30	0.14	0.042	0.56	0.16	0.001
	SEEDSch	0.20	0.06	0.002	-0.01	0.07	0.933	0.04	0.07	0.581
	R^2 Change			0.09			0.00			0.004
3	**FRL Students with ELA Outcome**									

[54] The variable Remote was not included in the matching because none of the SEED schools remaining in the final sample were in remote areas. Therefore, other non-SEED schools in remote areas were also removed from the dataset prior to matching.

#	Sample	Y1 Outcome			Y2 Outcome			Y3 Outcome		
		β	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*
	SmallSch	0.01	0.04	0.798	-0.021	0.031	0.499	-0.04	0.03	0.244
	MID	0.02	0.04	0.488	0.17	0.03	0.000	0.14	0.03	0.000
	HIGH	-0.01	0.05	0.893	0.06	0.04	0.166	-0.04	0.04	0.323
	ELMMID	-0.08	0.06	0.210	-0.15	0.05	0.005	-0.08	0.06	0.162
	MIDHIGH	0.03	0.06	0.612	0.17	0.05	0.001	0.09	0.06	0.125
	Remote	0.05	0.07	0.547	-0.15	0.06	0.020	0.04	0.07	0.568
	MinorityGP	-0.07	0.04	0.096	-0.09	0.03	0.010	-0.19	0.04	0.000
	FRLGP1	0.06	0.05	0.157	0.08	0.04	0.040	0.07	0.05	0.155
	FRLGP2	0.00	0.07	0.960	0.14	0.06	0.018	0.16	0.06	0.016
	ELGP1	-0.10	0.04	0.010	-0.15	0.03	0.000	0.00	0.04	0.899
	ELGP2	-0.09	0.07	0.196	-0.09	0.06	0.142	0.10	0.07	0.143
	ELA_0	0.52	0.08	0.000	0.36	0.07	0.000	0.34	0.07	0.000
	SEEDSch	0.07	0.05	0.184	0.08	0.04	0.054	0.03	0.05	0.564
	R^2 Change			0.006			0.01			0.001
4	**All Students with Math Outcome**									
	SmallSch	0.07	0.04	0.127	0.02	0.05	0.663	0.04	0.06	0.542
	MID	0.02	0.05	0.732	0.12	0.06	0.037	0.10	0.07	0.150
	HIGH	0.00	0.05	0.955	0.04	0.05	0.455	0.03	0.07	0.617
	ELMMID	0.18	0.06	0.003	0.14	0.06	0.031	0.13	0.08	0.104
	MIDHIGH	0.04	0.05	0.432	-0.02	0.05	0.763	0.04	0.06	0.496
	K12	0.17	0.11	0.125	0.13	0.12	0.264	0.04	0.14	0.775
	Remote	-0.11	0.05	0.028	0.09	0.06	0.106	0.03	0.07	0.722
	MinGP1	0.00	0.06	0.995	-0.07	0.06	0.231	-0.05	0.07	0.470
	MinGP2	0.01	0.11	0.925	-0.03	0.12	0.810	-0.03	0.14	0.826
	FRLGP1	-0.10	0.06	0.086	-0.06	0.06	0.374	-0.10	0.08	0.206
	FRLGP2	-0.18	0.08	0.022	-0.04	0.08	0.631	-0.07	0.10	0.500
	ELGP1	-0.04	0.05	0.439	0.02	0.05	0.649	0.01	0.07	0.841
	ELGP2	-0.11	0.09	0.272	-0.11	0.10	0.278	0.09	0.13	0.500
	$Math_0$	0.78	0.06	0.000	0.83	0.06	0.000	0.66	0.07	0.000
	SEEDSch	0.04	0.04	0.337	0.02	0.04	0.634	0.03	0.05	0.634
	R^2 Change			0.002			0.00			0.001
5	**Minority Students with Math Outcome**									
	SmallSch	-0.04	0.06	0.437	0.04	0.07	0.587	-0.09	0.09	0.304
	BuildingGP	0.04	0.04	0.303	0.02	0.05	0.704	-0.06	0.06	0.293
	MinorityGP	0.05	0.04	0.274	-0.09	0.05	0.075	0.24	0.07	0.001
	FRLGP	-0.13	0.05	0.017	0.01	0.06	0.892	-0.23	0.08	0.005
	ELGP	-0.03	0.06	0.615	-0.08	0.07	0.242	0.05	0.09	0.623
	$Math_0$	0.36	0.12	0.004	0.69	0.14	0.000	0.39	0.18	0.041
	SEEDSch	0.09	0.05	0.072	0.03	0.06	0.656	0.11	0.07	0.152
	R^2 Change			0.03			0.001			0.03
6	**FRL Students with Math Outcome**									
	SmallSch	-0.03	0.03	0.293	0.06	0.04	0.143	0.08	0.03	0.018
	MID	-0.01	0.03	0.820	0.02	0.04	0.624	-0.02	0.03	0.620
	HIGH	0.02	0.04	0.574	0.07	0.04	0.103	-0.06	0.04	0.082
	ELMMID	-0.11	0.04	0.013	-0.21	0.05	0.000	-0.08	0.05	0.089
	MIDHIGH	-0.17	0.05	0.001	0.03	0.06	0.575	-0.08	0.05	0.124
	Remote	0.05	0.07	0.444	-0.06	0.08	0.460	0.20	0.07	0.003

#	Sample	Y1 Outcome			Y2 Outcome			Y3 Outcome		
		β	*SE*	*p*	*β*	*SE*	*p*	*β*	*SE*	*p*
	MinGP1	-0.07	0.04	0.060	-0.01	0.05	0.814	-0.02	0.04	0.621
	MinGP2	-0.13	0.08	0.084	-0.20	0.09	0.037	-0.05	0.08	0.494
	FRLGP1	0.00	0.04	0.987	0.12	0.05	0.008	0.06	0.04	0.146
	FRLGP2	0.06	0.05	0.231	0.33	0.06	0.000	0.06	0.06	0.384
	ELGP1	-0.17	0.03	0.000	-0.09	0.04	0.014	-0.04	0.03	0.196
	ELGP2	-0.14	0.05	0.008	-0.19	0.06	0.002	-0.19	0.05	0.001
	$Math_0$	0.58	0.06	0.000	0.62	0.07	0.000	0.42	0.06	0.000
	SEEDSch	0.06	0.05	0.257	0.09	0.05	0.099	0.03	0.05	0.535
	R^2 Change			0.002			0.006			0.001

Table C2. Sample Sizes, Adjusted and Unadjusted Group Means, and Unadjusted Standard Deviations of Outcome Measures

#		SEED Schools				Non-SEED Schools			
		n	*Adjusted-M*	*Unadjusted-M*	*SD*	*n*	*Adjusted-M*	*Unadjusted-M*	*SD*
1	**All Students with ELA Outcome**								
	Y1 ELA	19	0.01	0.02	0.42	80	-0.03	0.00	0.33
	Y2 ELA	19	0.03	0.00	0.39	79	-0.03	-0.03	0.31
	Y3 ELA	18	0.08	0.05	0.33	80	-0.02	-0.05	0.30
2	**Minority Students with ELA Outcome**								
	Y1 ELA	7	-0.11	-0.14	0.33	43	-0.31	-0.39	0.20
	Y2 ELA	7	0.00	-0.20	0.35	42	0.01	-0.23	0.22
	Y3 ELA	7	-0.08	-0.23	0.25	42	-0.12	-0.30	0.24
3	**FRL Students with ELA Outcome**								
	Y1 ELA	12	-0.06	-0.30	0.38	154	-0.13	-0.34	0.22
	Y2 ELA	15	-0.14	-0.30	0.28	151	-0.22	-0.37	0.21
	Y3 ELA	12	-0.22	-0.35	0.23	136	-0.25	-0.38	0.21
4	**All Students with Math Outcome**								
	Y1 Math	18	0.09	0.03	0.41	71	0.05	-0.04	0.37
	Y2 Math	18	-0.02	-0.02	0.42	70	-0.04	-0.07	0.36
	Y3 Math	17	-0.01	-0.01	0.38	69	-0.04	-0.08	0.31
5	**Minority Students with Math Outcome**								
	Y1 Math	7	-0.11	-0.18	0.24	50	-0.20	-0.26	0.17
	Y2 Math	7	-0.02	-0.19	0.38	50	-0.05	-0.22	0.23
	Y3 Math	7	-0.17	-0.23	0.28	50	-0.28	-0.34	0.20
6	**FRL Students with Math Outcome**								
	Y1 Math	12	0.06	-0.34	0.36	238	0.00	-0.36	0.26
	Y2 Math	15	-0.13	-0.33	0.27	244	-0.22	-0.40	0.26
	Y3 Math	12	-0.21	-0.35	0.25	206	-0.24	-0.40	0.20

Table C3. Baseline Characteristics of the Y1 Study Samples

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
1	**All Students with ELA Outcome**								
	SmallSch	19	0.68	0.48	80	0.66	0.48	0.94 (0.017 / 0.018)	0.05
	MID	19	0.16	0.37	80	0.14	0.35		0.06
	HIGH	19	0.16	0.37	80	0.15	0.36		0.02
	ELMMID	19	0.11	0.32	80	0.12	0.33		-0.06
	MIDHIGH	19	0.16	0.37	80	0.17	0.37		-0.02
	K12	19	0.05	0.23	80	0.03	0.18		0.09
	Remote	19	0.16	0.37	80	0.14	0.34		0.07
	MinorityGP	19	0.26	0.45	80	0.25	0.44		0.03
	FRLGP1	19	0.58	0.51	80	0.54	0.50		0.08
	FRLGP2	19	0.21	0.42	80	0.23	0.43		-0.05
	ELGP1	19	0.42	0.51	80	0.41	0.49		0.03
	ELGP2	19	0.05	0.23	80	0.03	0.18		0.09
	ELA_0	19	-0.02	0.45	80	0.01	0.38		-0.08
2	**Minority Students with ELA Outcome**								
	SmallSch	7	0.14	0.38	43	0.15	0.36	1.35 (0.057 / 0.042)	-0.01
	BuildingGP	7	0.71	0.49	43	0.60	0.50		0.24
	FRLGP	7	0.43	0.53	43	0.44	0.50		-0.02
	MinorityGP	7	0.29	0.49	43	0.35	0.48		-0.13
	ELGP	7	0.57	0.53	43	0.68	0.47		-0.23
	ELA_0	7	-0.21	0.36	43	-0.23	0.24		0.11
3	**FRL Students with ELA Outcome**								
	SmallSch	12	0.50	0.52	154	0.70	0.46	0.47 (0.023 / 0.049)	-0.41*
	MID	12	0.25	0.45	154	0.27	0.45		-0.05
	HIGH	12	0.08	0.29	154	0.13	0.34		-0.14
	ELMMID	12	0.08	0.29	154	0.09	0.28		-0.02
	MIDHIGH	12	0.08	0.29	154	0.08	0.27		0.01
	Remote	12	0.00	0.00	154	0.05	0.22		-0.32*
	MinorityGP	12	0.33	0.49	154	0.41	0.49		-0.16
	FRLGP1	12	0.58	0.51	154	0.65	0.48		-0.13
	FRLGP2	12	0.08	0.29	154	0.12	0.33		-0.12
	ELGP1	12	0.50	0.52	154	0.50	0.50		0.00
	ELGP2	12	0.08	0.29	154	0.06	0.24		0.08
	ELA_0	12	-0.39	0.32	154	-0.35	0.21		-0.14
4	**All Students with Math Outcome**								
	SmallSch	18	0.67	0.49	71	0.76	0.43	0.97 (0.034 / 0.035)	-0.21
	MID	18	0.17	0.38	71	0.14	0.35		0.07
	HIGH	18	0.17	0.38	71	0.16	0.37		0.01
	ELMMID	18	0.11	0.32	71	0.10	0.31		0.02
	MIDHIGH	18	0.17	0.38	71	0.21	0.41		-0.10
	K12	18	0.00	0.00	71	0.03	0.17		-0.25
	Remote	18	0.11	0.32	71	0.14	0.35		-0.09
	MinGP1	18	0.28	0.46	71	0.26	0.44		0.03
	MinGP2	18	0.00	0.00	71	0.03	0.18		-0.26
	FRLGP1	18	0.61	0.50	71	0.63	0.49		-0.04

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
	FRLGP2	18	0.17	0.38	71	0.20	0.40		-0.08
	ELGP1	18	0.39	0.50	71	0.34	0.48		0.11
	ELGP2	18	0.06	0.24	71	0.04	0.21		0.05
	$Math_0$	18	-0.01	0.41	71	-0.06	0.38		0.11
5	**Minority Students with Math Outcome**								
	SmallSch	7	0.14	0.38	50	0.08	0.28	0.96 (0.046 / 0.048)	0.18
	BuildingGP	7	0.71	0.49	50	0.78	0.42		-0.13
	MinorityGP	7	0.43	0.53	50	0.51	0.50		-0.16
	FRLGP	7	0.29	0.49	50	0.32	0.47		-0.07
	ELGP	7	0.57	0.53	50	0.44	0.50		0.25
	$Math_0$	7	-0.15	0.37	50	-0.16	0.22		0.04
6	**FRL Students with Math Outcome**								
	SmallSch	12	0.50	0.52	238	0.53	0.50	0.97 (0.035 / 0.036)	-0.06
	MID	12	0.25	0.45	238	0.25	0.44		-0.01
	HIGH	12	0.08	0.29	238	0.16	0.37		-0.24
	ELMMID	12	0.08	0.29	238	0.14	0.35		-0.18
	MIDHIGH	12	0.08	0.29	238	0.07	0.25		0.06
	Remote	12	0.00	0.00	238	0.04	0.19		-0.27*
	MinGP1	12	0.33	0.49	238	0.26	0.44		0.15
	MinGP2	12	0.00	0.00	238	0.03	0.17		-0.25
	FRLGP1	12	0.58	0.51	238	0.58	0.49		0.01
	FRLGP2	12	0.08	0.29	238	0.13	0.33		-0.14
	ELGP1	12	0.50	0.52	238	0.43	0.50		0.13
	ELGP2	12	0.08	0.29	238	0.07	0.26		0.03
	$Math_0$	12	-0.42	0.33	238	-0.39	0.28		-0.08

* The standardized mean difference on the variable was greater than 0.25.

Table C4. Baseline Characteristics of the Y2 Study Samples

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
1	**All Students with ELA Outcome**								
	SmallSch	19	0.68	0.48	79	0.66	0.48	0.94 (0.017 / 0.018)	0.06
	MID	19	0.16	0.37	79	0.14	0.35		0.06
	HIGH	19	0.16	0.37	79	0.15	0.36		0.02
	ELMMID	19	0.11	0.32	79	0.12	0.32		-0.03
	MIDHIGH	19	0.16	0.37	79	0.17	0.38		-0.02
	K12	19	0.05	0.23	79	0.04	0.19		0.09
	Remote	19	0.16	0.37	79	0.13	0.33		0.09
	MinorityGP	19	0.26	0.45	79	0.25	0.44		0.02
	FRLGP1	19	0.58	0.51	79	0.53	0.50		0.09
	FRLGP2	19	0.21	0.42	79	0.24	0.43		-0.06
	ELGP1	19	0.42	0.51	79	0.41	0.50		0.02
	ELGP2	19	0.05	0.23	79	0.04	0.19		0.09
	ELA_0	19	-0.02	0.45	79	0.02	0.38		-0.10

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
2	**Minority Students with ELA Outcome** [55]								
	SmallSch	7	0.14	0.38	42	0.15	0.36	1.34 (0.057 / 0.042)	-0.02
	BuildingGP	7	0.71	0.49	42	0.61	0.49		0.21
	FRLGP	7	0.43	0.53	42	0.42	0.50		0.01
	MinorityGP	7	0.29	0.49	42	0.36	0.49		-0.15
	ELGP	7	0.57	0.53	42	0.70	0.46		-0.25
	ELA_0	7	-0.21	0.36	42	-0.25	0.23		0.13
3	**FRL Students with ELA Outcome**								
	SmallSch	15	0.60	0.51	151	0.69	0.46	0.51 (0.022 / 0.043)	-0.19
	MID	15	0.20	0.41	151	0.26	0.44		-0.13
	HIGH	15	0.13	0.35	151	0.12	0.33		0.03
	ELMMID	15	0.13	0.35	151	0.09	0.29		0.13
	MIDHIGH	15	0.13	0.35	151	0.09	0.29		0.13
	Remote	15	0.07	0.26	151	0.05	0.22		0.07
	MinorityGP	15	0.33	0.49	151	0.43	0.50		-0.19
	FRLGP1	15	0.60	0.51	151	0.64	0.48		-0.09
	FRLGP2	15	0.13	0.35	151	0.12	0.33		0.03
	ELGP1	15	0.47	0.52	151	0.51	0.50		-0.08
	ELGP2	15	0.07	0.26	151	0.07	0.26		-0.03
	ELA_0	15	-0.40	0.29	151	-0.36	0.21		-0.15
4	**All Students with Math Outcome**								
	SmallSch	18	0.67	0.49	70	0.76	0.43	0.97 (0.034 / 0.035)	-0.21
	MID	18	0.17	0.38	70	0.14	0.35		0.06
	HIGH	18	0.17	0.38	70	0.16	0.37		0.01
	ELMMID	18	0.11	0.32	70	0.09	0.29		0.05
	MIDHIGH	18	0.17	0.38	70	0.21	0.41		-0.11
	K12	18	0.00	0.00	70	0.03	0.17		-0.25
	Remote	18	0.11	0.32	70	0.13	0.34		-0.06
	MinGP1	18	0.28	0.46	70	0.27	0.44		0.03
	MinGP2	18	0.00	0.00	70	0.03	0.18		-0.26*
	FRLGP1	18	0.61	0.50	70	0.63	0.49		-0.04
	FRLGP2	18	0.17	0.38	70	0.20	0.40		-0.09
	ELGP1	18	0.39	0.50	70	0.34	0.48		0.10
	ELGP2	18	0.06	0.24	70	0.05	0.21		0.05
	$Math_0$	18	-0.01	0.41	70	-0.05	0.38		0.10
5	**Minority Students with Math Outcome**								
	SmallSch	7	0.14	0.38	50	0.08	0.28	0.95 (0.046 / 0.048)	0.18
	BuildingGP	7	0.71	0.49	50	0.78	0.42		-0.13
	MinorityGP	7	0.43	0.53	50	0.51	0.51		-0.15
	FRLGP	7	0.29	0.49	50	0.32	0.47		-0.07
	ELGP	7	0.57	0.53	50	0.44	0.50		0.25
	$Math_0$	7	-0.15	0.37	50	-0.17	0.22		0.04

[55] The variable Remote was not included in the matching because none of the SEED schools remaining in the final sample were in remote areas. Therefore, other non-SEED schools in remote areas were also removed from the dataset prior to matching.

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
6	**FRL Students with Math Outcome**								
	SmallSch	15	0.60	0.51	244	0.54	0.50	1.00 (0.034 / 0.034)	0.12
	MID	15	0.20	0.41	244	0.25	0.43		-0.11
	HIGH	15	0.13	0.35	244	0.16	0.37		-0.07
	ELMMID	15	0.13	0.35	244	0.14	0.35		-0.01
	MIDHIGH	15	0.13	0.35	244	0.09	0.29		0.14
	Remote	15	0.07	0.26	244	0.03	0.18		0.14
	MinGP1	15	0.33	0.49	244	0.28	0.45		0.11
	MinGP2	15	0.00	0.00	244	0.03	0.17		-0.24
	FRLGP1	15	0.60	0.51	244	0.59	0.49		0.02
	FRLGP2	15	0.13	0.35	244	0.12	0.33		0.03
	ELGP1	15	0.47	0.52	244	0.42	0.50		0.09
	ELGP2	15	0.07	0.26	244	0.10	0.30		-0.11
	$Math_0$	15	-0.44	0.30	244	-0.39	0.27		-0.18

* The standardized mean difference on the variable was greater than 0.25.

Table C5. Baseline Characteristics of the Y3 Study Samples

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
1	**All Students with ELA Outcome**								
	SmallSch	18	0.67	0.49	80	0.66	0.48	0.89 (0.017 / 0.019)	0.01
	MID	18	0.17	0.38	80	0.14	0.35		0.09
	HIGH	18	0.17	0.38	80	0.15	0.36		0.05
	ELMMID	18	0.11	0.32	80	0.11	0.32		-0.01
	MIDHIGH	18	0.17	0.38	80	0.16	0.37		0.00
	K12	18	0.06	0.24	80	0.03	0.18		0.11
	Remote	18	0.17	0.38	80	0.14	0.35		0.08
	MinorityGP	18	0.22	0.43	80	0.26	0.44		-0.09
	FRLGP1	18	0.61	0.50	80	0.54	0.50		0.14
	FRLGP2	18	0.17	0.38	80	0.23	0.43		-0.16
	ELGP1	18	0.44	0.51	80	0.42	0.50		0.05
	ELGP2	18	0.00	0.00	80	0.03	0.18		-0.21
	ELA_0	18	0.01	0.44	80	0.01	0.38		0.00
2	**Minority Students with ELA Outcome**[56]								
	SmallSch	7	0.14	0.38	42	0.15	0.36	1.34 (0.057 / 0.042)	-0.02
	BuildingGP	7	0.71	0.49	42	0.61	0.49		0.21
	FRLGP	7	0.43	0.53	42	0.42	0.50		0.01
	MinorityGP	7	0.29	0.49	42	0.36	0.49		-0.15
	ELGP	7	0.57	0.53	42	0.70	0.46		-0.25
	ELA_0	7	-0.21	0.36	42	-0.25	0.23		0.13
3	**FRL Students with ELA Outcome**								
	SmallSch	12	0.50	0.52	136	0.66	0.48	0.53	-0.32

[56] The variable Remote was not included in the matching because none of the SEED schools remaining in the final sample were in remote areas. Therefore, other non-SEED schools in remote areas were also removed from the dataset prior to matching.

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		
	MID	12	0.25	0.45	136	0.28	0.45	(0.024 / 0.045)	-0.06
	HIGH	12	0.17	0.39	136	0.13	0.33		0.11
	ELMMID	12	0.08	0.29	136	0.10	0.30		-0.05
	MIDHIGH	12	0.08	0.29	136	0.09	0.29		-0.03
	Remote	12	0.00	0.00	136	0.06	0.23		-0.34
	MinorityGP	12	0.25	0.45	136	0.47	0.50		-0.45
	FRLGP1	12	0.67	0.49	136	0.70	0.46		-0.06
	FRLGP2	12	0.00	0.00	136	0.14	0.34		-0.56*
	ELGP1	12	0.50	0.52	136	0.53	0.50		-0.07
	ELGP2	12	0.00	0.00	136	0.07	0.26		-0.39
	ELA_0	12	-0.38	0.31	136	-0.38	0.21		-0.02
4	**All Students with Math Outcome**								
	SmallSch	17	0.65	0.49	69	0.76	0.43	0.92	-0.24
	MID	17	0.18	0.39	69	0.13	0.34	(0.034 / 0.037)	0.13
	HIGH	17	0.18	0.39	69	0.17	0.37		0.03
	ELMMID	17	0.12	0.33	69	0.10	0.30		0.07
	MIDHIGH	17	0.18	0.39	69	0.21	0.41		-0.09
	K12	17	0.00	0.00	69	0.03	0.17		-0.25
	Remote	17	0.12	0.33	69	0.12	0.32		0.01
	MinGP1	17	0.24	0.44	69	0.27	0.45		-0.08
	MinGP2	17	0.00	0.00	69	0.03	0.18		-0.27*
	FRLGP1	17	0.65	0.49	69	0.62	0.49		0.05
	FRLGP2	17	0.12	0.33	69	0.20	0.41		-0.23
	ELGP1	17	0.41	0.51	69	0.35	0.48		0.13
	ELGP2	17	0.00	0.00	69	0.05	0.21		-0.31
	$Math_0$	17	0.02	0.39	69	-0.04	0.38		0.16
5	**Minority Students with Math Outcome**								
	SmallSch	7	0.14	0.38	50	0.08	0.28	0.96	0.18
	BuildingGP	7	0.71	0.49	50	0.78	0.42	(0.046 / 0.048)	-0.13
	MinorityGP	7	0.43	0.53	50	0.51	0.51		-0.15
	FRLGP	7	0.29	0.49	50	0.32	0.47		-0.07
	ELGP	7	0.57	0.53	50	0.44	0.50		0.25
	$Math_0$	7	-0.15	0.37	50	-0.17	0.22		0.04
6	**FRL Students with Math Outcome**								
	SmallSch	12	0.50	0.52	206	0.54	0.50	1.00	-0.08
	MID	12	0.25	0.45	206	0.28	0.45	(0.035 / 0.035)	-0.07
	HIGH	12	0.17	0.39	206	0.17	0.38		-0.01
	ELMMID	12	0.08	0.29	206	0.12	0.33		-0.12
	MIDHIGH	12	0.08	0.29	206	0.08	0.27		0.02
	Remote	12	0.00	0.00	206	0.04	0.20		-0.21
	MinGP1	12	0.25	0.45	206	0.30	0.46		-0.12
	MinGP2	12	0.00	0.00	206	0.03	0.18		-0.19
	FRLGP1	12	0.67	0.49	206	0.66	0.47		0.01
	FRLGP2	12	0.00	0.00	206	0.10	0.31		-0.35*
	ELGP1	12	0.50	0.52	206	0.47	0.50		0.06
	ELGP2	12	0.00	0.00	206	0.09	0.28		-0.31*
	$Math_0$	12	-0.41	0.32	206	-0.43	0.27		0.08

#	Study Sample	SEED Schools			Non-SEED Schools			Variance of the PS ratio	Standardized Mean Difference
		N	*M*	*SD*	*N*	*M*	*SD*		

* The standardized mean difference on the variable was greater than 0.25.