

Offering Rural Elementary Teachers Modest Supports to Sustain Professional Development Outcomes in Science and Engineering

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INTRODUCTION

State and national reports over many years indicate that elementary teachers continue to feel less prepared to teach science when compared to mathematics and language arts. Nationally, only 17% of elementary teachers report feeling even fairly well prepared to teach engineering (Banilower et al., 2018).

High-quality science and engineering instruction requires teachers who are efficacious and prepared (Dorph et al., 2011). Realizing the *Framework's* ambitious vision of learning and the integration of engineering design, which are embodied by the NGSS (NRC, 2012; NGSS Lead States, 2013), necessitates high-quality professional learning (PL) to shift teachers' instructional practices (Britton et al., 2020; Nilsen et al., 2020).

Research acknowledges that contexts and conditions often affect the enactment of innovations, and "improving education requires processes for changing individuals, organizations, and systems" (Century & Cassata, 2016, p. 172). In this way, teachers' place is an important consideration.

BACKGROUND

Roughly 7.3 million public school students are enrolled in rural school districts in the U.S., and another 2 million students attend rural schools located within districts that are not designated rural by the U.S. Census Bureau (Showalter et al., 2023).

Geographic separation between schools is common among sparsely populated, rural areas. Some remote communities are classified as "frontier" (U.S. Department of Agriculture, 2019). Teachers in rural schools often have smaller collegial networks, and they may have fewer opportunities to participate in targeted PL (Harmon & Smith, 2007).

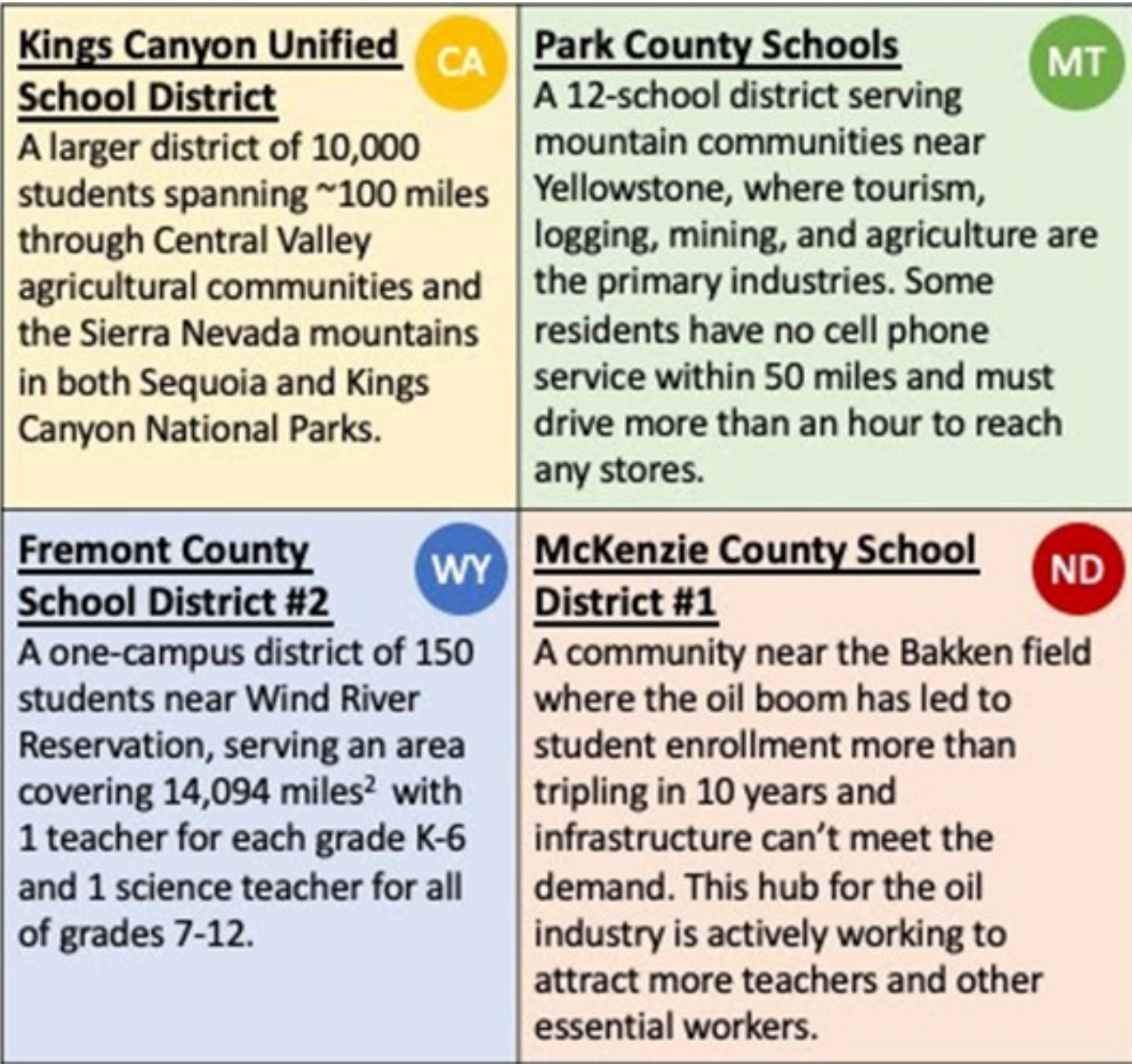


Figure 1. Plurality of Rural Schools Among Participating States

THEORETICAL FRAMEWORK

Questions persist about classroom implementation of the NGSS (e.g., Brunsell et al., 2014). Teachers can be introduced to key aspects of the NGSS, including three-dimensional learning, phenomena-based learning, engineering, student agency, equity, and coherence (Iveland et al., 2019). Of these aspects, researchers have found teachers struggle to implement engineering, especially in challenging circumstances (Iveland et al., 2021).

Studies show PL boosts teachers' self-efficacy (Lakshmanan et al., 2011) and affords them opportunities to practice new approaches while learning the content (Bartels et al., 2019). Unfortunately, teacher outcomes have been shown to decline following PL, and, over time, teachers have reverted to about the same level as before the PL. Interventions accompanied by modest, on-going supports have been shown to reverse downward trends (Sandholtz & Ringstaff, 2020).

Teachers are situated within district, school, and classroom contexts (Lave & Wenger, 1991), and these are nested within state-level ecological systems (Bronfenbrenner, 1979). Understanding classroom implementation and outcomes requires an understanding of place.

INTERVENTION

The intervention began with a 5-day online PL experience for teachers in each of four states: CA, MT, ND, and WY. This PL was designed and developed for elementary teachers using online platforms (Desimone, 2009), which was delivered by WestEd's K-12 Alliance team.

Table 1. Goals set for STEM STRONG 5-day Summer 2023 PL Institute

Summer 2023 Goals	Examples of PL Content				
Participating teachers will understand...	Asynchronous activities	Synchronous activities			
Instructional shifts called for by NGSS	Before Day 1: Reading <i>A Framework for K-12 Science Education</i> (NRC, 2012, Chapter 2)	Day 1:	Day 2:	Day 3:	Day 4:
Three dimensions support students' sensemaking of phenomena and solving problems	Before Day 2: Reading "Making the Shift in Practice" (Bang et al., 2017, pp. 36-38)	Day 1:	Day 2:	Day 3:	Day 4:
Authentic, relevant, and meaningful science and engineering instruction supports all students	Before Day 3: Review of grade-specific NGSS-aligned units and lessons	Day 1:	Day 2:	Day 3:	Day 4:
NGSS-aligned instruction builds on students' prior knowledge and leverages students' resources and skills to position them as knowers	Before Day 4: Reflecting on excerpts from "How People Learn" (National Academies, 2000, 2018)	Day 1:	Day 2:	Day 3:	Day 4:
NGSS-aligned instruction that approximates the work of scientists and engineers positions students as knowers and doers	Before Day 5: Reflecting on current assessments used as part of science teaching	Day 1:	Day 2:	Day 3:	Day 4:
Formative assessment opportunities provide potential to support teacher facilitation of students engaging as knowers and doers		Day 1:	Day 2:	Day 3:	Day 4:

Modest supports that have been offered during the 2023-2024 academic year, including online professional learning community (PLC) sessions and dedicated electronic supports (e.g., Google Site, shared resources, etc.).

1. Virtual Professional Learning Community (PLC)	1. Virtual PLC Meetings 3 Whole group sessions with all teachers 4 State cohort sessions
2. Resource Library	2. STEM STRONG PL Landing Page and Google Folder Teachers will keep access to all PL materials from K-12 Alliance
3. Dedicated Project Share Space	3. STEM STRONG Google Classroom - Research Team will compile resources recommended during the PL - We will also share free (or low-cost) high quality resources to support S&E instruction
4. Project Newsletter	4. STEM STRONG will have a column in a monthly newsletter - Research Team will contribute a column to an existing newsletter(s) and STEM STRONG teachers will get articles - Our focus will be on S&E education in connection with place and rural issues
5. NGSS Lesson Support	5. Guided support implementing NGSS lessons - Guided walkthrough of engineering design lesson (Fall 2023). - Guided walkthrough of science lesson with formative assessment (Spring 2024).
6. Other project-specific electronic supports	6. Optional supports to support your needs - Staying connected through social media groups - Sharing materials on affinity platforms (e.g., Pinterest) - Additional (optional) virtual S&E PL opportunities (e.g., webinars) - Virtual opportunities to interact with other teachers (e.g., NGSS Chat)

Figure 2. Modest Supports Offered to Participants During 2023-2024

METHODS

The multi-year funded project has 4 overarching research objectives, two ROs are presently being investigated as part of this study:

- 1) Assessing the extent to which an intense 5-day science and engineering professional learning (PL) has immediate impacts teachers' knowledge and self-efficacy in science and engineering; and
- 2) Observing the effectiveness of modest supports on the sustainability of PL outcomes.

Measures. Since the beginning of the project, various types of data have been collected. Quantitative measures have included surveys about teachers' backgrounds, scales related to self-efficacy and related constructs, and measures of pre- and post-PL outcomes. Qualitative measures have included interviews and written content.

This poster focuses on 540 open-ended responses teachers provided about their day-to-day learning during the 5-day summer PL along with their perceived needs related to enacting NGSS-aligned instruction.

Sample. Approximately 151 elementary teachers across four states participated in the intervention. Participants were divided among grades 3 (n=42), 4 (n=34) and 5 (n=29), and some taught multiple (n=46). More than half (55%) had been teaching for more than 10 years. All participants had experience teaching in rural schools prior to participating in the PL.

RESULTS

We identified common themes using Atlas.ti 23.4 and the categories reflected teachers' common perspectives (Maxwell, 2013).

Table 2. Elementary Teachers' Self-reported Growth Related to Understanding the NGSS

Codes	Frequencies					Totals
	Day 1	Day 2	Day 3	Day 4	Day 5	
NGSS: Familiarity	23	2	6	2	5	38
NGSS: 3 Dimensions	15	0	2	1	1	19
NGSS: Phenomena	18	31	1	0	1	51
NGSS: 3-D Instruction	22	1	29	1	11	64
Engineering Design	8	0	0	62	0	70

Teachers also commented specifically about their increased confidence (15 instances),

"The entire engineering process was easier than I thought it would be and can see implementing it in my room" (Day 4).

Table 3. Elementary Teachers' Self-reported Growth Related to NGSS-aligned Instructional Shifts

Codes	Frequencies					Totals
	Day 1	Day 2	Day 3	Day 4	Day 5	
Students as knowers: Prior knowledge	6	2	1	1	6	16
Students as knowers: Peer collaboration	7	4	0	1	2	14
Students as knowers: Sensemaking	0	12	2	0	2	16
Teachers as facilitators	2	14	1	2	1	20

Some number of teachers (ranging 5-14) commented each day about the value and benefit of having time to work in groups and collaborate (55 instances total). As examples,

"A chance to collaborate and discuss with other elementary educators..." and

"It was great to see that other people that lived in the other states had a lot ... in common with my experiences..." (Day 1).

Table 4. Elementary Teachers' Self-reported Challenges and Concerns

Codes	Frequencies					Totals
	Day 1	Day 2	Day 3	Day 4	Day 5	
Aligning current curriculum with the NGSS	7	4	2	1	4	18
Connecting lessons with NGSS dimensions	0	0	12	8	1	21
Assessing student learning	1	2	0	5	11	19

Teachers said they needed,

"Assistance in understanding best forms of assessment for science and engineering" and

"How to ensure you are recognizing growth in your students in those areas..." (Day 5).

Table 5. Elementary Teachers' Requests for Additional Supports

Codes	Frequencies					Totals
	Day 1	Day 2	Day 3	Day 4	Day 5	
Resources to learn more about the NGSS	7	10	10	5	11	43
NGSS-aligned lessons	4	1	7	3	5	20
Practice delivering 3-D S&E in classrooms	6	6	5	2	7	26

Evaluation of the 5-day PL, see Galisky et al. (2024), shows that teachers' attitudes towards teaching science and engineering along with teachers' self-efficacy significantly improved between pre- and immediate post-intervention ($p < .001$). The present findings continue the conversation between teacher PL and supporting positive changes in classrooms.



NEXT STEPS

The intervention continues through May 2024 and participants will continue meeting in PLC sessions, focusing on their delivery of engineering and science lessons.

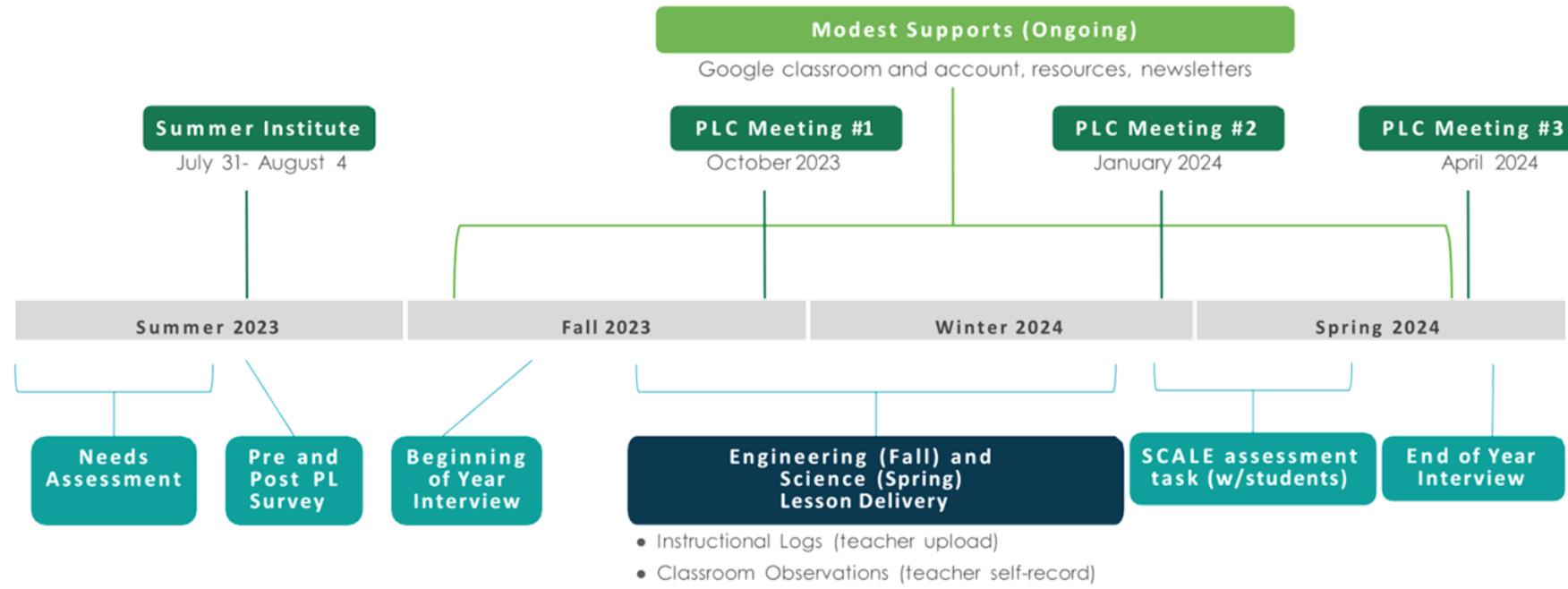


Figure 3. Research and Professional Learning Activities for 2023-2024

Participants will be invited to continue with the project during the 2024-2025 academic year. Modest supports will continue to be offered along with PL and PLC sessions. Research will expand to look more deeply at teachers' choice of modest supports and impacts on classroom teaching and learning.

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