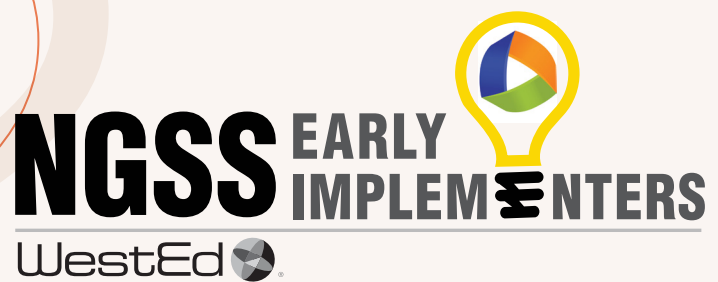


Six Years of Scaling Up: Districtwide Implementations of the Next Generation Science Standards

Burr Tyler, Ted Britton, Kimberly Nguyen, Denise Estrella, Elizabeth Arnett, Ashley Iveland, Katy Nilsen



NGSS Early Implementers Initiative: Bringing Science to Life as a Core Subject in K–8 Classrooms

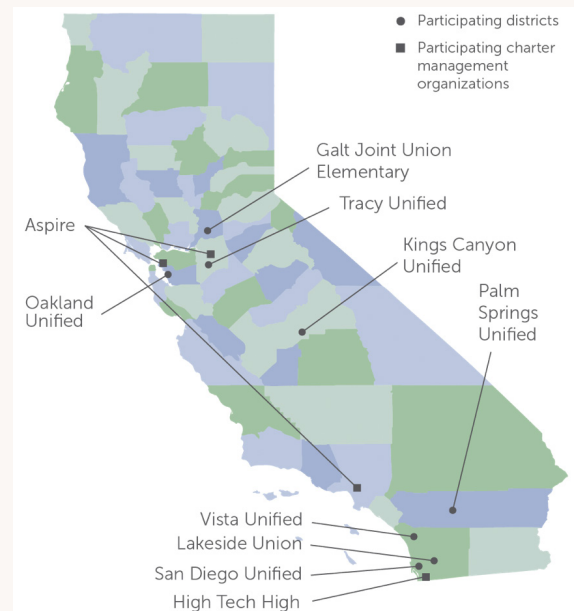
A diverse group of eight California school districts and two charter management organizations is actively implementing the Next Generation Science Standards (NGSS). The progress, experiences, and lessons of the NGSS Early Implementers, as they are called, can inform others implementing the NGSS. The Early Implementers are supported by the K–12 Alliance at WestEd and work in partnership with the California Department of Education, the California State Board of Education, and Achieve. Funding for the Early Implementers Initiative (the Initiative) is provided by the S. D. Bechtel, Jr. Foundation, and the Hastings/Quillin Fund is supporting participation by the charter organizations.

The Initiative spans 2014 through 2020. It focuses on NGSS implementation in grades K–8 and incorporates the integrated course model (preferred by the California State Board of Education) for middle school.

Teachers are supported with strategies and tools, including an instructional framework that incorporates phenomena-based learning. This framework aligns with the three NGSS dimensions: disciplinary core ideas, crosscutting concepts, and science and engineering practices. Using science notebooks, questioning strategies, and other approaches, students conduct investigations, construct arguments, analyze text, practice descriptive skills, articulate ideas, and assess their own understanding.

Teachers engage in science lesson studies twice each year through a Teaching Learning Collaborative. In each district, the Initiative is guided by a Core Leadership Team composed of Teacher Leaders and administrators who participate in additional professional learning and coaching activities. Together, this core team and an extended group of Teacher Leaders are the means for scaling NGSS implementation throughout the district.

Learn more about this multiyear initiative and access evaluation findings as well as instructional resources at k12alliance.org/ca-ngss.php.



© 2020 WestEd. All rights reserved.

Suggested citation: Tyler, B., Britton, T., Nguyen, K., Estrella, D., & Arnett, E. (2020). *Six years of scaling up districtwide implementations of the Next Generation Science Standards*. WestEd.

WestEd — a nonpartisan, nonprofit research, development, and service agency — works with education and other communities throughout the United States and abroad to promote excellence, achieve equity, and improve learning for children, youth, and adults. WestEd has more than a dozen offices nationwide, from Washington and Massachusetts to Arizona and California, with headquarters in San Francisco. For more information, visit WestEd.org, call 877.493.7833, or email us at info@WestEd.org.

Requests for permission to reproduce any part of this report should be directed to WestEd Publications Center, 730 Harrison Street, San Francisco, CA 94107-1242, 888.293.7833, fax 415.512.2024, permissions@WestEd.org, or <http://www.WestEd.org/permissions>.

Contents

Evaluation of the NGSS Early Implementers Initiative	iv
Executive Summary	v
Introduction	1
Background	1
Focus of This Report	4
Advances in Expansion Teachers' NGSS Practice	5
How Districts Reached All K–8 Teachers of Science	9
District-Level Strategies for Reaching Expansion Teachers	9
Training of Trainers	9
Academies	10
Lesson Studies	11
Summer Institutes	12
Districtwide Policies for NGSS Teaching and Learning	13
Required Science Minutes in the Elementary Grades	13
Instructional Materials Adoption	13
Making Use of Districtwide Teacher Professional Learning Days	14
Site-Based Strategies for Reaching Expansion Teachers	14
Menu of Professional Learning Modules	14
NGSS Site Leads	15
Making Use of Existing Teacher Collaboration Structures	16
Less Formal Collaboration in Schools	16
Administrators and Districtwide NGSS Implementation	18
How Administrators Supported Districtwide NGSS Implementation	18
District Strategies for Helping Administrators Understand the NGSS	19
Effectiveness of Scale-Up Strategies	20
According to Districts	20
What Was Tried That Was Less Effective	21
Sustaining and Building on Accomplishments	23
Moving Forward with the NGSS Amid the COVID-19 Pandemic	24
Recommendations	25
References	27

Appendix A. Data Sources	28
Appendix B. What Expansion Teachers Understand About the NGSS	29
Glossary	34

List of Figures

Figure 1. Progression over time of Initiative professional learning for teachers and administrators	3
Figure 2. Frequency that expansion teachers reported using various NGSS teaching strategies during the 2019–20 school year	6
Figure B1. Expansion teachers’ understanding of “the Science and Engineering Practices (SEPs) within the NGSS and how they are used during instruction” in Years 4, 5, and 6 of the Initiative	30
Figure B2. Expansion teachers’ understanding of “the Crosscutting Concepts (CCCs) within the NGSS and how they are used during instruction” in Years 4, 5, and 6 of the Initiative	30
Figure B4. Expansion teachers’ understanding of engineering design in NGSS instruction in Years 4, 5, and 6 of the Initiative	32

List of Tables

Table 1. Percentage of elementary expansion teachers who reported teaching more or less science compared to the previous year	7
Table 2. Strongest reported influences on elementary expansion teachers teaching more or less science than the previous year	8

Evaluation of the NGSS Early Implementers Initiative

In addition to this current report #12, evaluators previously released the following:

- *The Needle Is Moving in California K–8 Science: Integration with English Language Arts, Integration of the Sciences, and Returning Science as a K–8 Core Subject* (Evaluation Report #1, October 2016)
- *The Synergy of Science and English Language Arts: Means and Mutual Benefits of Integration* (Evaluation Report #2, October 2017)
- *Administrators Matter in NGSS Implementation: How School and District Leaders Are Making Science Happen* (Evaluation Report #3, November 2017)
- *Developing District Plans for NGSS Implementation: Preventing Detours and Finding Express Lanes on the Journey to Implement the New Science Standards* (Evaluation Report #4, February 2018)
- *Next Generation Science Standards in Practice: Tools and Processes Used by the California NGSS Early Implementers* (May 2018)
- *Making Middle School Science Whole: Transitioning to an Integrated Approach to Science Instruction* (Evaluation Report #5, October 2018)
- *Engaged and Learning Science: How Students Benefit from Next Generation Science Standards Teaching* (Evaluation Report #6, November 2018)
- *Investing in Science Teacher Leadership: Strategies and Impacts in the NGSS Early Implementers Initiative* (Evaluation Report #7, February 2019)
- *Collaborative Lesson Studies: Powerful Professional Learning for Implementing the Next Generation Science Standards* (Evaluation Report #8, September 2019)
- *Environmental Instruction Catalyzes Standards-Based Science Teaching: How Environmental Literacy Aids Implementation of the NGSS* (Evaluation Report #9, September 2019)
- *Administrators Matter In NGSS Implementation (2019): Updated Findings on How School and District Leaders are Making Science Happen* (Evaluation Report #10, October 2019)
- *It's About TIME: A Rigorous New Process for Selecting Instructional Materials for Science* (Evaluation Report #11, April 2020)

Executive Summary

Many educational initiatives are funded for only a couple of years. The California NGSS Early Implementers Initiative spanned an extraordinary six years, during which eight school districts worked toward districtwide implementation of the Next Generation Science Standards (NGSS), which call for teachers to transform their instructional practice. This 12th report in our evaluation series for policymakers, school and district administrators, and professional learning specialists describes the Initiative's scale-up in its later years to reach all K–8 science teachers. Specifically, the report addresses the following questions:

- › In contrast to focusing in Years 1–4 on developing Teacher Leaders, what strategies did districts use in Years 5–6 to reach all other K–8 teachers of science (called “**expansion teachers**” in this report)?
- › What impacts has the Initiative had on expansion teachers?
- › Which professional learning strategies have been most and least effective for influencing the practice of expansion teachers?
- › What special attention was paid to providing administrators with professional learning to prompt their support of NGSS implementation?

Advances in Expansion Teachers' NGSS Practice

Majorities of expansion teachers in both the elementary and middle grades reported shifting their science instruction in a range of NGSS

teaching practices that were modeled in the professional learning and support provided by Early Implementer Teacher Leaders. At the elementary level, in each of the three years they were surveyed, more than one-third of expansion teachers said they taught more science than the previous year. Almost two-thirds of them said they would be comfortable teaching a science lesson for their principal as part of their professional evaluation.

How Districts Reached All K–8 Teachers of Science

In Years 1–4, professional learning and support for Teacher Leaders was designed by the Initiative's central leadership and run similarly in all the Initiative's districts. In contrast, in Years 5–6, each district had more design and implementation autonomy for reaching teachers at large. Indeed, districts used varied models for their overall district NGSS implementation policies and strategies, districtwide professional learning offerings, and school-level professional learning and support.

District NGSS implementation policies and strategies. Four districts established new policies requiring minimum weekly minutes of science instruction in the elementary grades. Further, districts sanctioned integrating science during the allotted instructional time for English language arts or English language development. Five districts engaged some expansion teachers, along with Teacher Leaders, in a rigorous process to select instructional materials for

adoption using the California NGSS Toolkit for Instructional Materials Evaluation (TIME). Several districts decided to include science in their districtwide contractual teacher professional learning days.

Districtwide professional learning. The following are the four primary types of districtwide professional learning opportunities offered, including two that were local adaptations of the main Initiative-wide professional learning activities of Years 1–4, the five-day Summer Institutes and the two-day lesson studies:

- Some of the local Summer Institutes consisted of shorter days or lasted fewer than five days, but they included similar activities as Summer Institutes of previous years. That is, all institutes involved teachers experiencing NGSS learning in hands-on lessons intended to model NGSS instruction, rather than being dominantly information-giving “NGSS 101” sessions.
- Districts tried widely varying adaptations of the Initiative’s Years 1–4 Teacher Learning Collaboratives (TLCs). TLCs were the Initiative’s version of lesson studies, which involved teachers planning a lesson together during a pull-out planning day, then teaching, revising, and reteaching it together during a pull-out teaching day.
- One large district created a train-the-trainer model providing five pull-out days per year for 300 teachers to participate in professional learning sessions called Science Capacity Builders.
- Two districts implemented “academies,” wherein teachers had opportunities to confer on how they were teaching multiweek instructional sequences.

School-level professional learning and support.

There were three main strategies for supporting

NGSS implementation by expansion teachers at the school level:

- Establishing NGSS teacher Site Leads at the school, whereby interested expansion teachers or Teacher Leaders could be liaisons between district Initiative leads and their school’s teachers and administrators, acting as a general resource to them for NGSS implementation support.
- Making use of existing teacher meetings, such as professional learning communities, grade-level meetings or faculty meetings at the elementary level, and science department meetings in middle schools.
- Developing a menu of professional learning sessions to experience NGSS teaching. Modules on popular topics were offered at different lengths, typically 45–120 minutes, to accommodate the needs and constraints of different schools; principals could select sessions to be offered at their schools.

Informal learning also played a critical role in school-level support, with teachers interacting and collaborating on an ad hoc basis, beyond the organized opportunities described previously.

Administrators and Districtwide NGSS Implementation

About two-thirds of expansion teachers reported that their principal was “very supportive” of their teaching the NGSS. Principal support resulted from the Initiative making a concerted effort to engage administrators and empower them to actively support their teachers’ NGSS implementation. All districts created an administrator strand at their Summer Institutes. One district required all principals to participate in a series of three two-hour, concentrated NGSS

professional learning sessions. Between meetings, they completed “homework assignments” at their sites, such as observing science instruction and responding to survey questions about what they saw. Most districts implemented some form of science walk-throughs, in which principals, accompanied by one or more Early Implementer participants, briefly visited a series of five to 10 classrooms where science was being taught. More than 90 percent of surveyed administrators reported that they participated in one or more science walk-throughs.

The report provides interview excerpts from administrators, project directors, and expansion

teachers wherein they describe the **effectiveness** of the scale-up strategies in this report, as well as caveats. While much has been accomplished in districts’ NGSS implementation, there are expansion teachers who still need to be reached; and among many of those who have already become involved, there is a need to make NGSS teaching the mainstay of their yearlong practice. Further, there is a particular need to keep this NGSS implementation momentum going in the context of altered teaching conditions being caused by COVID-19. The report closes with a dozen brief **recommendations** for district leaders on NGSS implementation.

Introduction

Many educational initiatives are funded for only a couple of years. The Early Implementers Initiative spanned an extraordinary six years, during which eight school districts worked toward districtwide implementation of the Next Generation Science Standards (NGSS), which call for teachers to transform their instructional practice.

Background

The initial plan for the Initiative envisioned scaling NGSS implementation to all the participating districts' K–8 teachers of science in four years. However, as the Initiative progressed, the S.D. Bechtel, Jr. Foundation and Initiative leaders realized that two additional funded years would be needed for districts to be able to more fully enact the substantial teaching changes called for by the NGSS.

Concurrent with the extension, Year 5 saw a pivot in Early Implementer professional learning, from the centralized strategy utilized in Years 1–4 to district-designed and delivered efforts in Years 5–6, when districts were afforded more autonomy and assumed larger financial responsibilities for their own NGSS implementation activities. Districts' professional learning strategies in Years 5–6 varied widely; this report describes those strategies and lessons learned about their effectiveness.

Our superintendent has said the way that we ran this [NGSS implementation], the way that we put this together, the way that it developed, is the way that we should be doing all of our initiatives. I think they recognize and have said that it's amazing the amount of work we were able to do, and how far we've moved, and that we are leaps and bounds past other districts when they go to their superintendent or other county-level or state-level meetings.

—District Project Director

To understand the Early Implementer NGSS districtwide implementation scale-up stories in this report, it is critical to understand the progression of teacher professional learning provided over the Initiative's six-year duration, illustrated in Figure 1. During the first four years, intensive professional learning in both leadership and NGSS implementation was provided first to teachers on the Core Leadership Teams. The following year, these district NGSS leaders began to train cohorts of 30–70 Teacher Leaders in each district. The teacher professional learning provided during these first four years was designed centrally by the Initiative's leadership team and carried out the same way in every district. The Teacher Leaders received similar but less intensive training than that provided to the Core Leadership Team teachers, with the expectation that the Teacher Leaders would, in turn, eventually share their NGSS

expertise with the other teachers of science in their districts.¹

One [key piece of advice for other districts] is investing in teacher leadership ... and making sure that each site has one teacher that can really live, breathe, and advocate for science. And then you start to create these leaders that actually end up moving up the system. (District Project Leader)

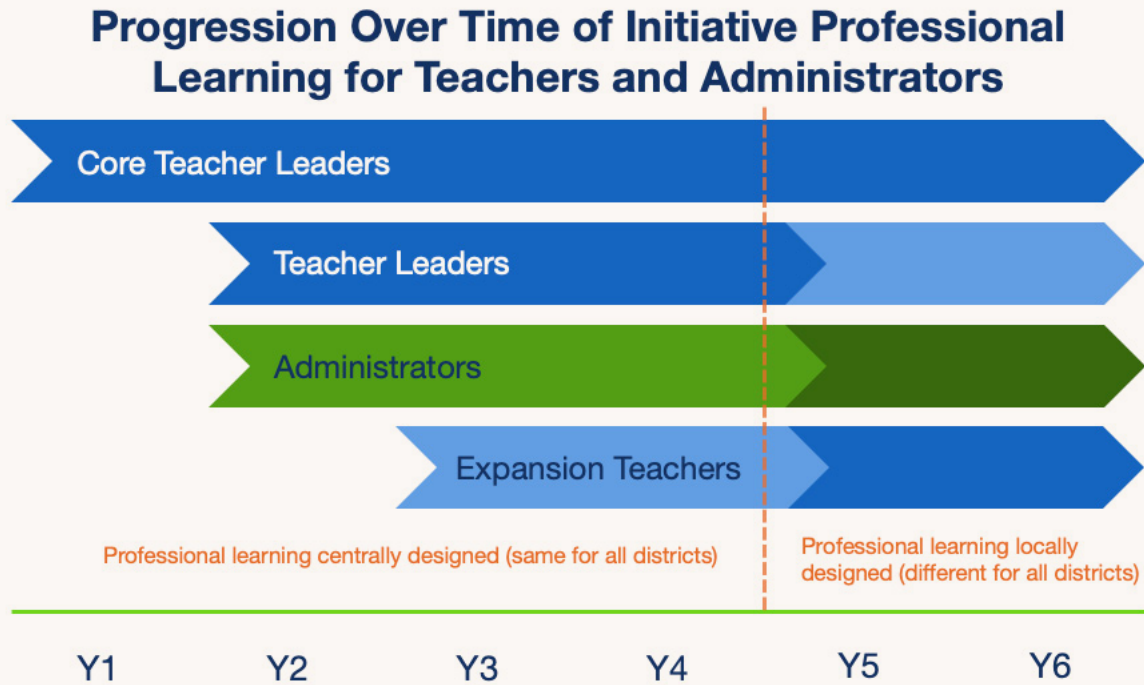
Three to five administrators were included as members of each district Core Leadership Team. These Core Administrators regularly received professional learning designed specifically for them and were also invited to participate in professional learning provided to Core Leadership Team teachers. However, early on, Initiative leaders realized the crucial role that all principals played in supporting NGSS implementation, and

professional learning for all K–8 administrators was included in the Initiative’s overall NGSS roll-out strategy. Core Administrators played a role in providing NGSS professional learning to other administrators.

We refer to all of the K–8 teachers of science not directly participating in the Initiative during Years 1–4, as *expansion teachers* in this report. Many expansion teachers started to hear about the Initiative and the NGSS in Year 3, when the Teacher Leaders were beginning to feel confident enough to share their new knowledge. Also, some districts held informational sessions for expansion teachers, led in most cases by Teacher Leaders. However, as shown in Figure 1, it was not until Year 5 that the Early Implementer districts substantially shifted their professional learning focus from Teacher Leaders to expansion teachers.

¹ Core Leadership Team teachers received more leadership training than Teacher Leaders and had opportunities to lead (e.g., they led Summer Institute sessions attended by the Teacher Leaders); Teacher Leaders led some district professional learning. For more on how the Initiative prepared teachers for leadership in NGSS teaching, see evaluation report #7, Investing in science teacher leadership: Strategies and impacts in the NGSS Early Implementers Initiative. <https://www.wested.org/resources/investing-in-science-teacher-leadership-ngss-early-implementers/>.

Figure 1. Progression over time of Initiative professional learning for teachers and administrators



Note: Shading pertains to concentration of professional learning; darker color = more focused professional learning geared specifically to the group, lighter color = less intensive professional learning provided for the group

Starting in Year 2, the Initiative worked to provide professional learning to all principals beyond those on the Core Leadership Teams. Most principals had very full plates and were focused on other priorities, leading to varied levels of administrator participation across the districts. However, through interviews over the course of the Initiative, evaluators found that the more administrators learned about NGSS instruction, the more interested and supportive they generally became.² In addition, over time, district Project

Directors and other Early Implementer leaders got more strategic about how to address the differentiated needs and interests of administrators. Consequently, Early Implementer district leaders learned how to tailor professional learning to the needs of individual principals, which yielded in Years 5–6 the most effective strategies to reach administrators (see the section later in this report, “District Strategies for Helping Administrators Understand the NGSS”).

² See page 16 in evaluation report #10, *Administrators matter in NGSS implementation (2019): Updated findings on how school and district leaders are making science happen*. <https://www.wested.org/resources/administrators-matter-in-ngss-implementation-2019/>.

Focus of This Report

Past reports in this series have discussed the professional learning provided to Teacher Leaders and administrators during Years 1–4 of the Initiative. This 12th report in the evaluation series describes how the Early Implementer districts scaled up that work to provide professional learning to expansion teachers and their principals. Specifically, the report addresses these questions:

- What impacts has the Initiative had on expansion teachers?
- What strategies did districts use during Years 5–6 to scale up implementation, shifting from focusing in earlier years on the Initiative’s Teacher Leaders to reaching expansion teachers?
- What special attention was paid to providing administrators with professional learning

to prompt and support their role in NGSS implementation?

- Which professional learning strategies have been most and least effective for influencing the practice of expansion teachers?
- What recommendations do Early Implementer participants and evaluators have for others endeavoring to achieve districtwide implementation of the NGSS?

Findings are based on dozens of interviews with Early Implementer leaders, Teacher Leaders, expansion teachers, and administrators; surveys over three years, completed by up to 1,000 of the Initiative’s teachers and administrators each year; and observations of professional learning activities for teachers and administrators in the Initiative’s eight school districts. (Details relating to data sources and collection are provided in Appendix A.)

Advances in Expansion Teachers' NGSS Practice

For an individual teacher, transitioning to NGSS instruction is far from a one-and-done prospect — it requires learning new terms and pedagogical concepts and making a series of significant shifts in practice. The Initiative's goal was for *all* expansion teachers to begin to shift their practice to align with the NGSS.

How far did expansion teachers get in their transition to NGSS teaching by the end of the six-year Initiative? Expansion teachers were asked how often they engaged in a range of NGSS teaching practices during the 2018–19 and 2019–20 school years (i.e., Years 5 and 6 of the Initiative). As shown in Figure 2, the practice they reported using the most was “questioning strategies to elicit student thinking.” When using this practice, teachers prompt students to discuss and make sense of scientific concepts and phenomena, rather than provide direct explanation and information for them. By the spring of 2020, more than half (58 percent) of expansion teachers reported using such questioning strategies **at least once per week**, and 80 percent reported using the practice **at least once per month**. This is a notable shift because teachers are often used to playing the role of “sage on the stage,” or the source of factual

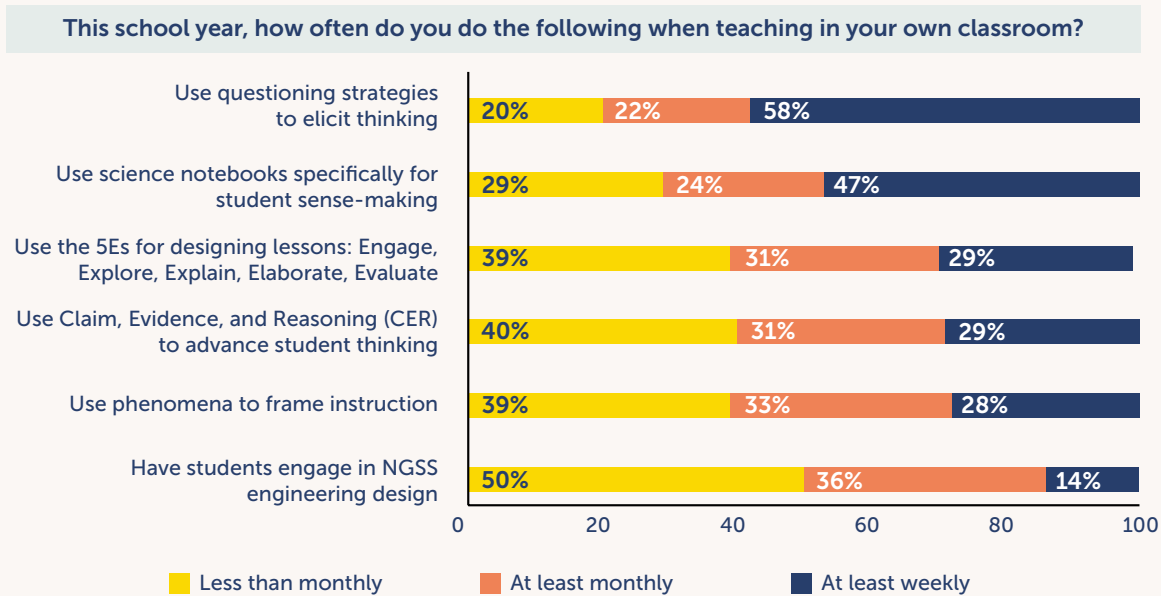
information responsible for telling students “the answer.” This approach to instruction can be a difficult habit for teachers to break, but they have reported in interviews that they are quickly recognizing the value for their students of doing so.

The second most common NGSS teaching strategy used by expansion teachers during the 2019–20 school year was “notebooks specifically for student sense-making.” Almost three-quarters (71 percent) of expansion teachers reported using notebooks **at least once a month**, and 47 percent did so **at least weekly**. Using science notebooks to support student learning was an integral component of Early Implementer professional learning since the first year of the Initiative.

There were three other teaching practices that a majority (about 60 percent) of expansion teachers said they engaged in **at least once a month**: “Using phenomenon to drive instruction” (61 percent); “Using the 5Es for designing lessons: Engage, Explore, Explain, Elaborate, Evaluate” (61 percent); and “Using Claim, Evidence, and Reasoning (CER) to advance student thinking” (60 percent). (See the Glossary for a brief explanation of these practices.³)

³ For more on the use of questioning strategies, notebooks, phenomena, the 5Es, and CER by the Early Implementers, see the special evaluation report, *Next Generation Science Standards in practice: Tools and processes used by the California NGSS Early Implementers*. <https://www.wested.org/resources/next-generation-science-standards-in-practice/>.

Figure 2. Frequency that expansion teachers reported using various NGSS teaching strategies during the 2019–20 school year



Source: Early Implementer Spring Survey 2020, administered to all expansion teachers in March–April 2020 (N=797).

Expansion teachers were also asked how often they had “students engage in NGSS engineering design.” Half (50 percent) of them said they did this on a monthly basis when teaching in their own classrooms. This is more impressive than it sounds because even the most proficient NGSS instructor would not have students engage in engineering in every science lesson because engineering makes up only part of the standards. There was lower incidence in teachers who reported “implementing three-dimensional (3D) instruction.” Thirty-nine percent of expansion

teachers said they did this once per month in 2020, up from 31 percent the previous year.

It is important to note that many elementary teachers were teaching little to no science before the Initiative. Beginning in 2017–18, surveyed elementary school expansion teachers were asked, “Did you teach notably more or less science this year compared to last year?” In each of the three years they were surveyed, more than one-third of elementary school expansion teachers said they taught more science than the previous year (see Table 1).

Table 1. Percentage of elementary expansion teachers who reported teaching more or less science compared to the previous year

Academic year	Teachers who taught more	Teachers who taught less
2017–18	35%	17%
2018–19	47%	12%
2019–20	38%	14%

Sources: 2017–18 Survey for K–8 Science Teachers, administered to all expansion teachers in May–June 2018 (N=610), and Early Implementer Spring Surveys, administered to all expansion teachers in May–June 2019 (N=507) and March–April 2020 (N=762).

Teachers who reported teaching more or less science than the previous year were asked a follow-up question about the strongest influences for the change (see Table 2). In **2018–19**, “Understanding the NGSS” was the biggest influence for teaching **more** science, followed by “Access to instructional materials” and “Opportunity to collaborate with other teachers.” In **2019–20**, the biggest influence for teaching **more** science was “Access to instructional materials.” “Access to science supplies” was the second biggest influence, and “Opportunity to collaborate with other teachers” was third. This provides evidence of the importance of administrators for teachers’ NGSS teaching: once teachers had gained understanding of the standards and were ready to implement them in their classrooms, the biggest influences on their teaching were dependent

on resources allocated by school and district administrators.

Similarly, “Change in school focus (e.g., increased/decreased focus on English language arts, math, science, etc.)” was the fifth most influential reason expansion teachers cited for teaching **more science in 2019–20**, and it was the number one reason expansion teachers said they taught **less science in both 2018–19 and 2019–20**. Not surprisingly, “Access to instructional materials,” “Access to science supplies,” and “Opportunity to collaborate with other teachers” were the other most influential reasons teachers cited for why they taught **less** science both years. The survey results suggest that expansion teachers are gaining both understanding about the standards and confidence in implementing them in their classrooms.

Table 2. Strongest reported influences on elementary expansion teachers teaching more or less science than the previous year

Academic year	Strongest influences for teachers who reported teaching more science than the previous year	Strongest influences for teachers who reported teaching less science than the previous year
2018–19	<ol style="list-style-type: none"> 1. "Understanding the NGSS" 2. "Access to instructional materials" 3. "Opportunity to collaborate with other teachers" 4. "Access to science supplies" 	<ol style="list-style-type: none"> 1. "Change in school focus (e.g., increased/decreased focus on English language arts, math, science, etc.)" 2. "Access to instructional materials" 3. "Access to science supplies" 4. "Opportunity to collaborate with other teachers"
2019–20	<ol style="list-style-type: none"> 1. "Access to instructional materials" 2. "Access to science supplies" 3. "Opportunity to collaborate with other teachers" 4. "Understanding the NGSS" 5. "Change in school focus" 	<ol style="list-style-type: none"> 1. "Change in school focus (e.g., increased/decreased focus on English language arts, math, science, etc.)" 2. "Access to instructional materials" 3. "Access to science supplies" 4. "Opportunity to collaborate with other teachers"

Sources: Early Implementer Spring Surveys, administered to all expansion teachers in May–June 2019 (N=299) and March–April 2020 (N=483).

Another significant indicator of progress in NGSS implementation is that a majority (63 percent) of surveyed elementary school expansion teachers in 2020 said they would be comfortable teaching

a science lesson for their principal as part of their professional evaluation. In fact, a quarter of expansion teachers (25 percent) said they would be "very comfortable" doing so.

How Districts Reached All K–8 Teachers of Science

Although the Initiative was still focusing on professional learning for Teacher Leaders in Year 4, Teacher Leaders had begun to share what they were learning with expansion teachers. For example, grade-level teams with Teacher Leader members planned NGSS lessons together, and expansion teachers tried out those lessons with their own students. In addition, many expansion teachers had been invited to districtwide and school-level informational NGSS sessions. By Year 5, as districts took over responsibility for designing and delivering NGSS professional learning, reaching all teachers became their priority. By this time, there were a relatively large number of Teacher Leaders equipped and willing to share their NGSS knowledge with their peers. A range of strategies was used, some at the district level, and some at the school level. As a companion to professional learning, most of the Early Implementer districts have created repositories on their district websites for sharing NGSS resources.

Underlying all these strategies was a key Early Implementer approach to professional learning: a gradual introduction to learning about the standards. Because the NGSS embody such a major shift from previous science standards, Initiative leaders wanted to avoid intimidating and overwhelming teachers. The expectation for changing instruction was invitational and flexible; teachers were initially encouraged to try just one new instructional strategy on their own with their students. This strategy of “start slow to go fast” — which supported teachers to experiment in a low-stakes context and then motivated them to challenge themselves by trying even more

sophisticated teaching strategies — characterized the professional learning approach of the Initiative as a whole.

When we switched to Common Core with [English language arts] and math, it was a hard shift. ... The initial rollout of NGSS has been very soft and ... “What are we getting ourselves into? Why do we have to make this change?” But the way that the kindergarten teachers have owned [NGSS teaching] and appreciated it and celebrated it, it definitely has generated a really positive buzz and excitement across the campus, and all the teachers want in. (Elementary School Principal)

District-Level Strategies for Reaching Expansion Teachers

Training of Trainers

One large district began a new STEAM program in the 2017–18 school year (Year 4 of the Initiative), and participating teachers volunteered to receive training and then be leaders at their sites. The program started with kindergarten and expanded to include an additional grade each year, with the goal of training two K–5 teachers to be “Science Capacity Builders” in as many elementary schools as possible.

Capacity Builders, according to a district recruiting flyer, are expected to “engage in active learning, ask clarifying questions, and contribute best practices to peers across the district. They are expected to meet with their administrators and other content area Capacity Builders to plan for actively building capacity at their site.”

Each year, teachers who volunteered to be Science Capacity Builders were brought together for five full days of NGSS professional learning, and their substitutes were paid for by the district. Teacher Leaders who had received NGSS professional learning through the Early Implementers Initiative acted as most of the program’s planners, presenters, and mentors. By Year 6, according to the district Project Director, the Capacity Builders professional learning strategy had provided NGSS professional learning to more than 300 teachers. Further, a district survey administered in May 2020 revealed that almost three-quarters (74 percent) of teachers participating in the Capacity Builders professional learning said they taught science three or more days per week, up from 36 percent who said this in May 2019.

What’s been the most valuable professional learning experience? I think the Capacity Builder training, since we met once a month ... [I learned from] being able to plan with the team of teachers who went, and being able to talk to them and have our lead teacher help us implement in the classroom. I think that’s where I felt like the other teachers [who didn’t participate] were missing out. Everybody should be going to this training. It shouldn’t just be me. (Elementary School Expansion Teacher)

Capacity Builders has helped me gain more understanding of how to teach NGSS, and I get to connect with other teachers about what they’re doing in their classroom ... They talk about assessment, how to assess with NGSS, how to deliver information to students, teaching based off phenomena. I think I would be pretty lost if I didn’t go to those because there was only one other science teacher at my school site that I didn’t get to collaborate with very often. That gave me a chance to collaborate with other teachers and see what they’re doing in their classroom, what’s working and not working. (Elementary School Expansion Teacher)

Academies

An “academy” was implemented in at least two districts. These academies gave expansion teachers a chance to teach a series of NGSS lessons and then debrief the experience with others who had recently taught the same lessons. In a series of meetings, teachers in the academies were given grade-specific, multiweek learning sequences developed either by the district or by the K–12 Alliance.⁴ At each academy meeting, teachers reviewed or experienced one to three lessons in the sequence that they would teach to their students before the group convened again. At the next meeting several weeks later, they brought student work with them, discussed how the lesson(s) went, and learned about the lesson(s) they would be trying in their classrooms before the next meeting.

⁴ As part of the Early Implementers Initiative, the K–12 Alliance has coordinated the development of grade-level learning sequences, including review and approval by Achieve, one of the organizations that spearheaded development of the NGSS. The learning sequences will be shared publicly on the K–12 Alliance website: <https://k12alliance.org/ca-ngss.php>.

That's where we got the most bang for our buck: by training teachers and having administrators be part of the team and then having that scale to the next level, and to the next level, at the point where it seemed like our plan worked so well that the next cohort or the next level of implementation was craving it right when we were ready to provide it. (District Project Director)

In a variation on the academy model, another district offered a series of three-hour professional learning sessions after school. Each session was based on a feature of the NGSS, such as using phenomena to drive instruction, arguing from evidence, or engaging in engineering design. Teachers learned about the particular NGSS feature for two hours, during which a sample NGSS lesson was modeled and a 5E instructional model lesson plan was discussed. The final hour was reserved for teachers to plan their own 5E lesson to teach in their classrooms. They received a stipend for their time only after submitting a complete lesson plan to the trainer, who also offered to provide feedback and/or come to a participating teacher's classroom to observe or assist with the lesson.

Yet another district arranged a half day for middle school teachers to observe a lesson taught by a Core Teacher Leader and then meet to discuss what they had seen.

There was [a professional learning session] this year where we got to watch a lesson being implemented in the classroom ... I think that was the most helpful because you could see what NGSS actually looked

like in an actual classroom setting in a 45-minute or one-hour block period. Then, talk about it, debrief, look at some of the student work — I found that really helpful ... I think I got a lot of clarity on notebooking. (Core Teacher Leader)

Lesson Studies

All Teacher Leaders in Years 1–4 engaged in two two-day lesson studies (referred to in the Initiative as Teaching Learning Collaboratives, or TLCs), one in the fall and one in the spring. In Year 5, all but one of the Early Implementer districts offered some form of the lesson study experience to interested expansion teachers.

At least one district went further by involving not only every K–8 teacher of science but also special education teachers at the elementary school level and English language arts teachers at the middle school level. In that district, each facilitated grade-level team met for a full day to plan a lesson; then teachers individually taught or co-taught at their sites; and then the teams reconvened after school during an early release day for a facilitated debrief of their experiences. Districtwide professional learning community (PLC) time was designated for that debrief. Each participant engaged in two such lesson studies in Year 5.

In Year 6, that district's Project Director wanted to remedy inconsistencies in implementation encountered with the district's model. The district reverted back to the format of the original Early Implementer TLC of Years 1–4 by keeping the grade-level teams together to co-teach the lesson during a second full day.⁵ To economize on time out of the classroom and use of substitute

⁵ For more information about Early Implementer TLCs, see evaluation report #8, *Collaborative lesson studies: Powerful Professional Learning for implementing the Next Generation Science Standards*. <https://www.wested.org/resources/powerful-professional-learning-for-implementing-the-next-generation-science-standards/>.

teachers, the district offered each participant just one full lesson study experience (i.e., a two-day duration) in Year 6.

A range of teachers, administrators, and project leaders have characterized lesson studies as one of the most effective professional learning activities teachers experienced through the Initiative.

The [professional development] was the best in science, because [the facilitators] were real teachers, they know our kids. They were very honest about the struggles they had, and they'd say, 'Here is one thing that happened with this lesson, so you can learn from me.' They seemed so comfortable .. I could tell they were excited about it too, and it felt like they were giving us really great resources. It just flowed really well, and I was excited to try it. We went away from it with everything that we needed ... We were just so gung-ho and ready to get started. (Elementary School Expansion Teacher)

Summer Institutes

The Early Implementers Initiative kicked off each of the first four years with a five-day regional Summer Institute that combined NGSS content, pedagogy, and leadership development. In Years 5 and 6, individual districts continued this practice by each holding its own local Summer Institute. In contrast to the centralized Summer Institutes in Years 1–4, districts opened these professional learning events up to all K–8 teachers and administrators rather than only Teacher Leaders. Some of these local events consisted of shorter days or lasted fewer than five days, but they included similar activities as Summer Institutes of previous

years. That is, teachers participated as students in hands-on lessons intended to model NGSS instruction that were led by teachers in partnership with university experts and also in sessions on tools and pedagogy supportive of NGSS teaching.

There was consensus among teachers and administrators that Summer Institutes were one of the most powerful professional learning experiences for teachers and one of the most effective in reaching expansion teachers.

I think [the Summer Institutes are] effective because [teachers] get a better sense of what [NGSS instruction] really would be like in a classroom. And I think it feels, even as the teacher who's experienced it, it feels very doable when you do it that way, versus trying to just explain it to somebody. (District Project Director)

Summer Institute is actually what made me the most excited because of how much I learned and how much I felt I grew as an educator, just during those three or four days ... I fell in love with the idea of phenomena at that Summer Institute as well and just being able to draw kids in. I think that was my total favorite part of the whole summer experience. (Elementary School Expansion Teacher)

Districtwide Policies for NGSS Teaching and Learning

Required Science Minutes in the Elementary Grades

From the beginning of the Initiative, Core Leadership Teams were providing professional learning to Teacher Leaders and asking them to begin to implement some element of the NGSS in their classrooms. One major barrier that elementary teachers faced was a school day already jam-packed with required instruction, particularly for English language arts and math. For teachers to start implementing the NGSS, districts needed to communicate to all teachers that science was an instructional priority, on par with other core subjects. One of the most effective ways that districts did so was by mandating a minimum number of weekly minutes of science instruction for each grade. One way that many elementary teachers made time to teach the NGSS was by integrating science with English language arts or English language development. NGSS science and English language arts are a natural fit because most of the NGSS science and engineering practices (e.g., asking questions, constructing explanations, arguing from evidence, evaluating information) are language-based.⁶

The first district to establish a policy of mandatory weekly minutes of science instruction did so in Year 2, requiring teachers in grades K–2 to teach a minimum of two hours and in grades 3–5

a minimum of two and a half hours. By the end of Year 4, three additional districts required 60 to 90 minutes of weekly science instruction for grades K–5. One Early Implementer district already had a weekly minimum minutes of science instruction requirement before joining the Initiative: 60 minutes for grades K–2 and 90 minutes for grades 3–5. Survey data from 2019–20 show that in districts with such a mandate, 56 percent of teachers reported teaching at least the minimum required hours of science instruction.

Instructional Materials Adoption

Another way that districts supported NGSS implementation was by investing in NGSS-aligned instructional materials because almost all of the districts recognized that adopting NGSS-aligned curriculum was important to achieving full districtwide NGSS implementation. By the time the California Department of Education released a list of publishers of science materials for adoption (January 2019), the Initiative was in its fifth year. During those five years, individual and groups of teachers, as well as the Initiative itself, had been developing their own instructional units and learning sequences.

Five districts have engaged or plan to engage Teacher Leaders in a rigorous collaborative process to select instructional materials for adoption, the California NGSS Toolkit for Instructional Materials Evaluation (TIME).⁷ Participants who were part of the TIME process felt that in addition to guiding them through the process of evaluating candidate materials, it also provided excellent professional learning about the standards.⁸ Four of

6 Evaluation report #2, *The synergy of science and English language arts: Means and mutual benefits of integration*, shows how many districts encouraged the integration of science and English language arts or English language development. <https://www.wested.org/resources/synergy-of-science-and-english-language-arts/>.

7 The toolkit is based on the original work of the K–12 Alliance.

8 For more information about the TIME toolkit, see evaluation report #11, *It's about TIME: A rigorous new process for selecting instructional materials for science*: <https://www.wested.org/resources/selecting-instructional-materials-for-science>.

the five districts that used TIME included expansion teachers in the process.

I don't know if this counts as training, but like I was telling you about the adoption committee [that used the TIME process] ... I feel like that was the most deep that I've gone with NGSS. [It helped me with] actually understanding what each of these performance expectations are and understanding the standards more ... and how I can tie it into everything, like understanding the SEPs and how I can tie engineering practices into my lessons. I feel like that was a really, really good training. (Elementary School Expansion Teacher)

Whether using TIME or another tool to guide the process of selecting materials, providing teachers with NGSS-aligned, high-quality instructional materials is necessary for NGSS implementation.

Making Use of Districtwide Teacher Professional Learning Days

While Teacher Leaders in the Early Implementer districts grew in their preparedness and willingness to share what they were learning about the NGSS, some districts continued to emphasize math and English language arts and did not make time for NGSS sessions during districtwide professional learning days. When science was included, Teacher Leaders who were receiving training in NGSS teaching as well as leadership typically led the sessions. Sometimes the focus of the NGSS professional learning was informational, and sometimes grade-level groups were led through hands-on investigations that modeled NGSS instruction. These presentations raised awareness of the NGSS. However, when there was no

follow-up to build on what attendees had learned, these one-off NGSS professional learning sessions did not have much impact on anyone's instruction.

Site-Based Strategies for Reaching Expansion Teachers

Over the course of the Initiative, there was increased demand for site-based rather than districtwide professional learning for a few reasons. As teachers tried NGSS teaching practices in their classrooms, they needed more tailored support, and there was a growing pool of Teacher Leaders with the expertise to provide this type of assistance at school sites. Further, to reduce the need for substitutes, as is necessary for professional learning that is off-site, professional learning sessions became smaller and less formal, and they moved to school staff or department meetings, PLCs, and early release times.

Menu of Professional Learning Modules

In one district, a strategy to scale up NGSS implementation to all teachers of science was for Core Teacher Leaders to provide school trainings, called "modules," on various aspects of the NGSS. Topics included individual science and engineering practices, using phenomena to drive instruction, using notebooks for sense-making, and others. Modules on popular topics were offered at different lengths, typically between 45 and 120 minutes, to accommodate the needs and constraints of different schools. Once a module was developed, typically by teachers on the Core Leadership Team, it could be delivered during a school staff meeting or department meeting by a pair of Early Implementer Teacher Leaders. The district emailed all K–8 principals to let them know about the growing menu of NGSS modules

they could “order” for their staff. Teachers valued professional learning led by their peers.

[The Teacher Leaders] did a fantastic job, and I think that they kind of brought down our anxiety about how to go about [NGSS teaching], and you realize the things that you’re doing ... [In] the old teaching, you front load and then you go over the vocabulary and all that business, and now it’s not like that. It’s a lot of self-exploration ... Some things we were already doing that we didn’t even really realize, like the weather graphing that we do, was already kind of part of the NGSS. So awesome, awesome, really grateful they have been there on our site to give us the support. (Elementary School Expansion Teacher)

NGSS Site Leads

As districts began to reach out to expansion teachers in earnest, four districts each designated one teacher to be the NGSS Site Lead for each school. Most Site Leads taught at the school they were assigned. Site Leads received a stipend to carry out responsibilities to support the NGSS instruction of teachers at the school.

In spring 2020 surveys, Site Leads reported the following when asked about their roles and responsibilities:

- All (100 percent) said that they talked about the NGSS in their PLCs.
- Most (92 percent) reported that they had talked informally at grade-level meetings.
- Most (92 percent) said they served as a resource for individual teachers who asked for help.
- Most (85 percent) said they helped other teachers identify or procure science activities or investigations.
- One-quarter (25 percent) said they formally presented about NGSS instruction at their schools.
- A small number (14 percent) formally presented about the NGSS in the district outside of their schools.

A major responsibility of Site Leads was to collaborate with their school principals. When doing so, they reported that they discussed teacher needs for supplies or equipment (56 percent), professional learning needs of teaching staff (50 percent), science instructional materials (50 percent), and NGSS activities in the school (50 percent).

While Teacher Leaders played strong roles in many scale-up activities, and they often served as Site Leads as well, several Site Lead roles were filled by expansion teachers. In 2019–20, 45 of the 66 Site Leads who took the survey in 2020 were expansion teachers. Of those 45 expansion teachers, 24 reported that they had been Site Leads the previous year as well. These expansion teachers, who had not attended the intensive NGSS professional learning that Teacher Leaders had in Years 1–4, received a variety of support to carry out their Site Lead responsibilities:

- In two districts, Site Leads benefited from training provided during the Summer Institute at the beginning of the school year. In addition, time was scheduled during the Summer Institute for Site Leads and school principals to begin to collaboratively plan the school’s NGSS implementation.
- In most districts, support was provided to Site Leads by the teachers on the Core Leadership Team. In two districts, each Site Lead had a designated Core Teacher Leader mentor.

- Site Leads in one district received professional learning in NGSS instruction and leadership in three after-school meetings each year.

One interviewed principal volunteered that a reason she greatly appreciated having the Site Lead at her school was because he helped keep her from letting other priorities move NGSS implementation to a back burner.

What was helpful for me as a leader was to have that Site Teacher Leader. I relied on him ... he stood up to be a leader and then I let him lead. That was like a beautiful thing that happened, because sometimes I think schools get stuck in the execution of things because the teacher or principal gets busy or something ends up happening at the last minute. (Elementary School Principal)

Making Use of Existing Teacher Collaboration Structures

Expansion teachers reported in surveys and interviews that informal conversations and collaboration with teachers and principals also had an influence on their science teaching. These interactions often took place in grade-level teams or PLCs.

When I meet with my PLC, they're able to ask me questions, and then of course I ask them questions as well. And it seems like most of us, if not all of us, take that back to our classroom and use that to help better teach NGSS. (Elementary School Expansion Teacher)

[Our Teacher Leaders] have been very helpful in terms of modeling, sharing

resources and sample lessons, sharing during our PLCs and our teacher meetings. And then, of course, general teacher collaboration along the way has been helpful for developing lessons, mostly within their grade level because in our school, we are very lucky to have a collaborative system where all teachers within a specific grade level have the same prep at the same time. (Middle School Principal)

Less Formal Collaboration in Schools

Some expansion teachers received help from other teachers by simply asking for advice or spontaneously discussing ideas or resources. Such interactions proved to be some of the most influential for expansion teachers' NGSS teaching.

Just seeing how [the Teacher Leader] takes the NGSS into her classroom is an inspiration. I want to do that too. Whenever I've brought up, 'Oh, I have this topic that I'm investigating,' she's always been, 'Oh, I have this that might work for you.' And she'll send it over or she will talk about it. She's a really great influence on teaching science in the class. (Bilingual Elementary School Expansion Teacher)

In surveys administered in May 2019 and April 2020, expansion teachers were asked, "How much impact did the following activities have on your science instruction this school year?" The same three activities were identified as the most impactful for both years: "Independent research/learning," "Interacting with other teachers (outside of professional learning)," and "Professional learning community (PLC)." Nearly

half (45 percent) of expansion teachers who completed the survey in 2019 said that independent research/learning had “Some” or “A lot” of impact on their science teaching. This increased to almost two-thirds (63 percent) in 2020. Ratings of the other two most impactful activities were not far behind, with 41 percent and 38 percent, respectively, in 2019 and 57 percent and 56 percent, respectively, in 2020.⁹

⁹ Other activities that teachers rated as comparatively less impactful included districtwide professional learning, schoolwide professional learning, and interacting with school administrators (outside of professional learning). Answer choices were N/A, No impact, A little, Some, A lot.

Administrators and Districtwide NGSS Implementation

By the time large numbers of expansion teachers were embarking on their NGSS journeys, most principals had some understanding of the intent of the standards and how to support teachers, and the administrators were continuing to receive professional learning.

How Administrators Supported Districtwide NGSS Implementation

Surveyed expansion teachers reported that their principals were even more supportive in 2020 than in 2019. In 2020, two-thirds (67 percent) of expansion teachers reported that their principal was very supportive of them teaching the NGSS in their classrooms, a slight increase from 61 percent in 2019. In 2020, more than half (57 percent) of expansion teachers said their principal was very supportive of them teaching science integrated with English language arts during designated English language arts time; and two-thirds (66 percent) reported that their principals encouraged teachers at their school to teach science.

Our administrators attended our PLC ... so that they can learn and grow about the content for science. ... They actually learned what it is that we did in class ... Another way that the administrators found out what was happening in science [was at] site leadership team [meetings] that met every two weeks. During that time, the

science Teacher Leader shared the content that was being taught. (Middle School Expansion Teacher)

Our principal has been extremely supportive ... [the Early Implementer Teacher Leader at our school] is generally given a time slot during our monthly staff meetings so she can go over things and [present about the NGSS]. (Elementary School Expansion Teacher)

I've had three different principals [and they have all been very supportive of the NGSS] ... We made sure from the very beginning to involve them in what we're doing. This is why it's better. We had them come see us to see what we're doing and to see the kids much more engaged ... They make time to meet with us ... And they've made sure we've had any supplemental material we need. (Middle School Expansion Teacher)

Our principal gives the Early Implementer Teacher Leader at our school a time slot during our monthly staff meetings to [present about the standards]. (Elementary School Expansion Teacher)

Administrator support proved to be important beyond supporting individual teachers' NGSS teaching. School administrators tend to carry

more influence at the district office than teachers do, which was sometimes crucial to getting needed support for NGSS activities; having a set of well-informed principals communicate support for NGSS to the district office was even more effective. The Initiative addressed the need for principal buy-in by providing professional learning for all K–8 principals to help them understand the intent of the NGSS as well as how to support teachers engaged in the challenging work of transitioning to new pedagogy.

District Strategies for Helping Administrators Understand the NGSS

In Years 5 and 6, three strategies were utilized most often as NGSS professional learning for principals:

Summer Institute sessions. Beginning in Year 2 of the Initiative (2015–16), administrators were encouraged to participate in the annual projectwide Summer Institutes for Teacher Leaders. Administrators attended one or two of the five days. They visited rooms where teachers were meeting and also attended sessions specifically planned for them.

At the Summer Institutes, I felt like my background in NGSS grew in a way that wasn't just, 'Here's what the standards look like.' It was seeing how they work, and how they can work for all kids. (Elementary School Principal)

Yearlong academy for all principals. One district made a strategic decision to prioritize districtwide professional learning for administrators in Year 5, leaving professional learning for teachers to take

place in less formal contexts. All principals were brought together in a series of brief but concentrated NGSS professional learning sessions. During each two-hour meeting, a feature of NGSS instruction was examined in detail. Between meetings, principals completed “homework assignments” at their sites, which included observing science instruction and responding to survey questions about what they saw. Aggregated survey responses were debriefed at the next meeting. Evaluators observed a sophisticated level of NGSS understanding on the part of principals in this district at the midyear point.

Science walk-throughs (also called “learning walks”). Most districts implemented some form of walk-throughs in which one or more principals, accompanied by one or more Early Implementer participants, briefly visit a series of five to 10 classrooms where science is being taught. Typically, a topic is selected on an observation tool in advance to focus the observations. After the tour, the group debriefs its observations and plans next steps such as possible professional learning for teachers at the site. In 2019–20, the vast majority (92 percent) of surveyed administrators said they had experienced at least one walk-through, and many (34 percent) said they had gone on more than six. More than two-thirds (69 percent) said that the walk-throughs impacted their understanding of the NGSS “some” or “a great deal.”¹⁰

Administrators were also asked to rate the impact of various people on their understanding of the NGSS. More than half (59 percent) said that interacting with teachers had impacted their understanding “some” or “a great deal,” and almost half (48 percent) said interacting with other administrators had this level of impact on their understanding.

10 For more information about the professional learning provided to administrators by the Early Implementers Initiative, see evaluation report #10, *Administrators matter in NGSS implementation (2019): Updated findings on how school and district leaders are making science happen.* <https://www.wested.org/resources/administrators-matter-in-ngss-implementation-2019/>.

Effectiveness of Scale-Up Strategies

According to Districts

Some superintendents and other district office leaders have commented that the strategies used by the Early Implementers Initiative to implement the NGSS were stronger than implementation strategies in other school subjects. They commented that they would like to use lessons learned from the Initiative when implementing new standards in other school subjects.

The way we're working with science can be a model for how we should be working in some of the other core areas as well. And they should kind of catch up in English and in math. (Assistant Superintendent)

My assistant superintendent was very gung-ho on the lesson study model and would love to have seen that implemented in other curricular areas. And it was implemented in math a little bit. The capacity-building model that we used in terms of developing some ... you know, a handful of experts to farm out to the school sites. That was highly revered too. It's not something I've seen take root in other disciplines. (District Project Director)

I think they understand and have expressed that the way this went down was as solid of a process as anything they've ever seen. It's been mentioned that

we would like to replicate that, particularly when they're talking about math and English language arts adoption, so not only the whole implementation of science across the district but also the evaluation of instructional materials and that process. Making teachers smarter is always a good strategy. I heard zero negative or less than stellar comments about how the process worked. All I heard was praise. (District Project Director)

I know that my associate superintendent has spoken quite a bit — she knows the research — about the power of lesson study to really affect behavioral change in teachers. She often says, and so does my superintendent, 'I don't know what we would have done without this work, this grant, and also all the efforts that really raised the awareness and priority of science in the district.' Our superintendent has used it to leverage another grant, and we've written two since then. Each one of those is about increasing our focus on science and STEM for all of our kids. (District Project Director)

District Project Directors were asked if any non-science professional learning in their districts had been modeled after Early Implementer activities. Three Project Directors noted that lesson studies had been held in other content areas, and two said

that multiday summer meetings, similar to the Initiative's Summer Institutes, had been held.

So they have started doing some lesson study in other subject areas. ... They really like that model. And I think involving the administrators and having them come in and see the lesson study planning process, and more often they actually do come to watch the lesson. So [in science] we really try to get the administrators in there. And sometimes there are like seven people in there because they've got the learning director, they've got the principal, they've got the instructional coach. They've got the facilitator. We've been doing it for a long time; I think we have institutionalized that process. (District Project Director)

Last year, the district held its first K–12 summer professional learning in all content areas. And I think that, while it was a vision of our academic director, we definitely influenced it from our NGSS experience, from both the logistical hurdles and the vision and structure. (District Project Director)

One Project Director explained how the Early Implementer lesson study experience in science influenced elementary teachers' teaching of other subjects.

So even when people had lesson study, it took a couple years, but there was a different way of thinking about lessons and student work and teaching overall that I think spilled over to other subject areas. It definitely informed our science practice.

What Was Tried That Was Less Effective

In interviews, district Project Directors were asked to identify ways that the district had attempted to support NGSS implementation that were not as successful as they had hoped. In the following, we relate comments on implementation efforts that ultimately were seen as being less effective for scaling up NGSS implementation with expansion teachers:

- Providing informational professional learning opportunities with little or no follow-up
- Having sessions that included too much information
- Not providing stipends for teacher participation in professional learning outside of contract time

I was thinking about how we offered districtwide training for teachers and ... it was for everyone, TK through 8, who wanted to learn more. Unfortunately, I wouldn't say that was ... well, it didn't work as well as expected. I'd say that this was really new for a lot of folks, and we only had ... things scheduled just a few times throughout the year. I don't know if that was enough for some teachers to feel confident to go back to their site and provide [professional learning] to their colleagues. (District Project Director)

A significant [professional learning event] I wouldn't do again is the rollout awareness day for all teachers in Year 1 (or was it Year 2?). We got into every grade level. And it went nowhere. It was too soon. We

didn't have a clear enough message: 'This is what we want you to try and how we'll support you.' It almost killed us. It was just too much too soon. We should have had something very specific, two hours, maybe twice in the year. Very specific like modeling. (K-12 Alliance Regional Director)

We tried to offer just freebies. After school, anybody who's interested come spend two hours with us on crosscutting concepts, or phenomenon-based instruction. If it wasn't paid time, we got no participation. (District Project Director)

Sustaining and Building on Accomplishments

After six years of NGSS implementation, it would not be an exaggeration to say that science instruction has been transformed in the eight Early Implementer districts. Not only that, but the Initiative and the NGSS have influenced teachers' instruction of other subjects as well. At the same time, there is plenty of need and opportunity to scale up NGSS instruction further. NGSS teaching has not yet reached or been taken up by every K–8 science teacher in these districts. Further, particularly among many of the expansion teachers who have embraced NGSS teaching, it takes time for them to transform their science teaching to make NGSS teaching their mainstay practice.

Before COVID-19, there already were uncertainties about whether the momentum created by the Early Implementers Initiative would continue, and even whether the progress achieved would be sustained, particularly at the elementary school level. The COVID-19 pandemic's impact on science teaching and schooling in general both exacerbates the standing uncertainties about scaling and adds some new dimensions to the challenge.

The good news is that in all eight districts, large numbers of K–8 teachers, beyond the 30–70 Teacher Leaders directly participating in the Initiative, have made great strides in enacting the NGSS in their classrooms. After learning about the standards, administrators and teachers alike generally support this new way of teaching because they see the deep and enduring benefits for students.¹¹ An infrastructure of teacher NGSS

expertise and leadership capacity has been established over the course of the Initiative that has the potential to support continued NGSS implementation. The large majority (84 percent) of Teacher Leaders and expansion teachers who were NGSS leaders at their school in 2019–20 said that they expected to continue to provide leadership in the NGSS, teaching to teachers next year, during the 2020–21 school year. Resources developed and lessons learned by the Early Implementers can and should be shared with other science educators throughout the state.

Further, NGSS leaders in at least four Early Implementer districts managed to get detailed plans for science included in their districts' Local Control and Accountability Plan (LCAP), which may increase the likelihood of getting support for NGSS professional learning. Many districts have set up repositories of NGSS resources and materials available to all teachers, and some have mandated minimum science instruction minutes. Five districts have adopted or plan to adopt vetted NGSS-aligned instructional materials; and those that have newly done so have plans for professional learning to help teachers understand how to use them.

11 For information about the impact of the NGSS on students, see evaluation report #6, *Engaged and learning science: How students benefit from Next Generation Science Standards teaching*. <https://www.wested.org/resources/engaged-and-learning-science/>.

Moving Forward with the NGSS Amid the COVID-19 Pandemic

Almost everything in education has been complicated by the COVID-19 pandemic that closed California schools in the spring of 2020. As of this writing, it is not entirely clear what school will look like in the 2020–21 school year. The ability to conduct hands-on science investigations and engineering design challenges will be hampered if some schooling is done virtually, which seems likely, at least in some locations. On top of that, severe budget issues are projected to befall districts across the state.

Despite seemingly daunting regular scale-up challenges, plus uncharted new challenges brought on by COVID-19, many Early Implementer participants feel strongly that NGSS implementation should and indeed will continue to be a priority in the coming years, as illustrated by the following comments from principals who were interviewed in the midst of this spring's COVID-19 pandemic.

I would love to continue to have [Early Implementers Teacher Leaders] share, learn, guide, and say, 'Here's what NGSS really looks like. Here it is in my classroom. Here's what we're actually doing. Here's how you can learn more and find out more and do more' ... I don't think it has to depend on whether schools open or how schools function next year ... I think that the leads can still have specific roles. What we've done is we've identified people who are leaders for technology and online instruction because they have familiarity with that. And so that was done as an immediate necessity to help people shift quickly into an online learning

platform ... right now, the problem is we don't have a vision of what's next. We have an idea, I guess. But once we have some more vision, then we can get back to the real work, which is continual learning, continual improvement, and not just being in this reactive mode. (Middle School Principal)

[The COVID-19 changes] actually might improve or increase the use of science because, in my opinion, science would be a great way to close some of those learning gaps. We have about 50 percent of our learners right now participating pretty fully in distance learning, and then probably another 25 percent that are doing about half the work. And then we have 25 percent of our students who are basically getting just simple packets, paper and pencil packets from the district. ... But in my thought process, as we figure out how we're going to try to tackle making up what students are not getting this third trimester of the school year, I think science is going to be one of those vehicles with which we can close [the learning gap] more easily again because you can target a lot of different standards in one lesson easily. (Elementary Principal)

Even with this distance learning, we're finding that the more efficient teachers can be with combining different things like science and math and language arts, the more they'll get out of the distance learning because the kids aren't in school for six hours with distance learning; they're in school for maybe two. (District Project Director)

Recommendations

Through many interviews with Early Implementer leaders, expansion teachers, and their administrators, the evaluation team recommends that, when scaling up new standards and pedagogy including the NGSS, district leaders consider the following recommendations:

1. Begin or continue a push for NGSS implementation that reaches *all* students in the district. Effective NGSS-aligned science teaching can be very appealing and engaging to students. Because science appeals to the natural curiosity of students about the world around them, it could help address the challenge that distance learning generally can seem more difficult for motivating and engaging students. Further, the nature of NGSS teaching gives it a natural synergy to be taught in conjunction with English language arts and other school subjects.
2. Plan for a multiyear scale-up for districtwide NGSS implementation. The pedagogical shifts called for by the NGSS are significant, and teachers need ongoing professional learning to make those shifts.
3. Build internal capacity to provide professional learning by investing in intensive training for a subset of teachers then leveraging that investment by providing opportunities for those teachers to act as leaders who share their expertise with others. Have a plan for Teacher Leaders, for other teachers, and for teachers when they are newly hired. As expansion teachers have indicated in surveys and interviews, peer-to-peer learning is one of the most effective professional learning contexts for teachers.
4. Make sure that NGSS professional learning includes opportunities for teachers to *experience* NGSS learning, rather than only telling them about it or demonstrating it.
5. Be mindful of not overwhelming teachers with too many new concepts and expectations all at once. As one Project Director put it, "If you are just starting [to scale up NGSS teaching], keep it simple."
6. Involve and train principals and other district leaders from the get-go. Principals should not just shadow teacher professional learning. There should be professional learning designed for and provided by administrators. In the Initiative, providing opportunities for administrators to collaborate with one another and with teachers was important to helping them understand NGSS instruction and how to support it.
7. Encourage administrators to devote time and attention to the NGSS in standing teacher meetings, such as PLCs, grade-level meetings, and faculty meetings.
8. Provide collaboration time so teachers can share learnings and resources. Teacher Leaders as well as expansion teachers have reported that interacting with other teachers is one of the most impactful experiences for instructional practice.
9. Set up NGSS resource-sharing on the district website for all teachers so individuals may benefit from what others have created or discovered.

10. Pay particular attention to teachers' need to access or acquire materials for students' hands-on investigations, a central feature of NGSS teaching. This need for materials applies, of course, to classroom-based investigations, but teachers also will face new challenges in figuring out how students can get or have materials when at home. Include funds for required supplies and materials in the district LCAP.
11. Support teachers by adopting carefully chosen NGSS-aligned instructional materials. If adopting instructional materials, provide ongoing, high-quality professional learning — in which teachers have multiple opportunities to review parts of the materials, teach them in their classrooms, and then reconvene to discuss their experiences and questions — rather than a "one and done."

References

Achieve. (2017). *Next Generation Science Standards district implementation indicators*.

California Department of Education. (2019). *Local Control Funding Formula*. <https://www.cde.ca.gov/fg/aa/lc/>.

Estrella, D., Tyler, B., Britton, T., Iveland, A., Nguyen, K., & Arnett, E. (2019). *Administrators matter in NGSS implementation (2019): Updated findings on how school and district leaders are making science happen*. WestEd.

NGSS Lead States. (2013). *Next Generation Science Standards: For states, by states*. The National Academies Press.

Tyler, B., Britton, T., Nilsen, K., Iveland, A., & Nguyen, K. (2019). *Investing in science teacher leadership: Strategies and impacts in the NGSS Early Implementers Initiative*. WestEd.

Tyler, B., & DiRanna, K. (2018). *Next Generation Science Standards in practice: Tools and processes used by the California NGSS Early Implementers*. WestEd.

Tyler, B., Iveland, A., Nilsen, K., Britton, T., Nguyen, K., Estrella, D., & Arnett, E. (2019). *Collaborative lesson studies: Powerful professional learning for implementing the Next Generation Science Standards*. WestEd.

Appendix A.

Data Sources

As part of its evaluation of the NGSS Early Implementers Initiative, the WestEd evaluation team collected a range of data over the course of the Initiative, including annual surveys, regular interviews, and observations of classroom instruction and professional learning activities.

Surveys

The Early Implementer evaluation conducted surveys in the spring/summer of 2015, 2016, 2017, 2018, 2019, and 2020 to learn about teacher and administrator understanding and behavior related to NGSS implementation. At first, only Core Leadership Team members and Teacher Leaders were surveyed. Starting in Year 4, K–8 expansion teachers and their principals were included in this broad yearly survey.

Surveys were completed by the following:

- Between 252 and 369 Teacher Leaders per year
- Between 585 and 868 expansion teachers per year
- Between 84 and 124 administrators per year

It's important to note that the surveys did not necessarily solicit input from every K–8 teacher in the Early Implementer districts. Teachers were only invited to take the survey if there was at least one Teacher Leader at their school, or if an Early Implementer teacher had been assigned to provide some NGSS professional learning at the school. By the fifth year, however, teachers and administrators in almost every school in the six smallest school districts that participated in the Initiative had received NGSS professional learning and were

therefore included in the survey. By the end of Year 6, the two largest districts in the Initiative were still working to reach teachers in some elementary and middle schools.

Interviews

Beginning in Year 4, expansion teachers from each Early Implementer district were interviewed each spring (i.e., May–June of 2018, May–June of 2019, and March–April of 2020) about their science teaching during the concluding school year.

Evaluators conducted hundreds of interviews during the last three years, as follows:

- Four interviews with nine Project Directors
- Three interviews with four to six Regional Directors
- Three interviews with 10 to 12 expansion teachers
- Three interviews with six to 26 administrators

Observations

Evaluators observed a range of professional learning activities attended by expansion teachers during Years 3–6, including:

- Every regional and local Summer Institute
- Lesson studies in every district
- Academies (where held)
- Formal district-level and site-level professional learning

Appendix B. What Expansion Teachers Understand About the NGSS

Understanding Features of the NGSS

Expansion teachers were asked each year how well they understood a range of major NGSS features and teaching tools that were addressed in Early Implementer professional learning. Survey data revealed that about half of expansion teachers who completed the evaluation surveys already understood NGSS features and teaching tools “fairly well” by the end of Year 4 of the Initiative (which was the first year that expansion teachers were surveyed). Notably, however, for all 16 of the NGSS features and tools listed in the survey, expansion teachers’ understanding steadily improved over the three years that they were surveyed.

Of the 16 NGSS features, expansion teachers rated their understanding of these major NGSS features the highest:

- Structure of the NGSS
- Each of the three NGSS dimensions and how each one is used during instruction
- Engineering design and how students engage in it
- Use of phenomena to drive science instruction
- How the NGSS relate to the Common Core State Standards

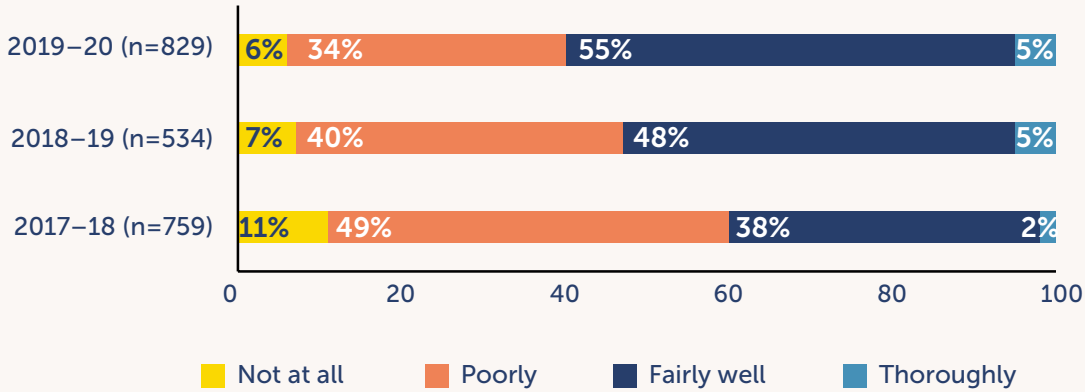
Of the NGSS features listed, “How the NGSS relate to the Common Core State Standards” was

best understood by expansion teachers. In 2018, more than half (54 percent) of expansion teachers reported that they understood this feature “fairly well” or “thoroughly.” By 2020, those understanding this feature “fairly well” or “thoroughly” increased to more than two-thirds (66 percent).

The NGSS feature that saw the most growth in understanding over the three years in which the expansion teachers were surveyed was “The use of phenomena to drive science instruction.” About half (52 percent) of expansion teachers reported that they understood this feature “fairly well” or “thoroughly” in 2018; that grew to almost three-quarters (74 percent) in 2020.

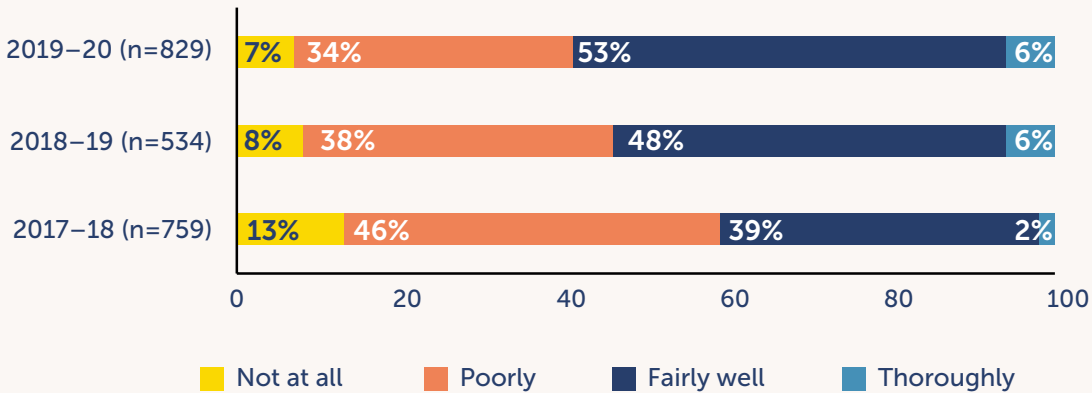
Interestingly, among the surveyed expansion teachers, all three NGSS dimensions (i.e., disciplinary core ideas, science and engineering practices, and crosscutting concepts) were the least understood of the NGSS features listed in 2018 and remained the least understood in 2020, as shown in Figures B1–B3.

Figure B1. Expansion teachers' understanding of "the Science and Engineering Practices (SEPs) within the NGSS and how they are used during instruction" in Years 4, 5, and 6 of the Initiative



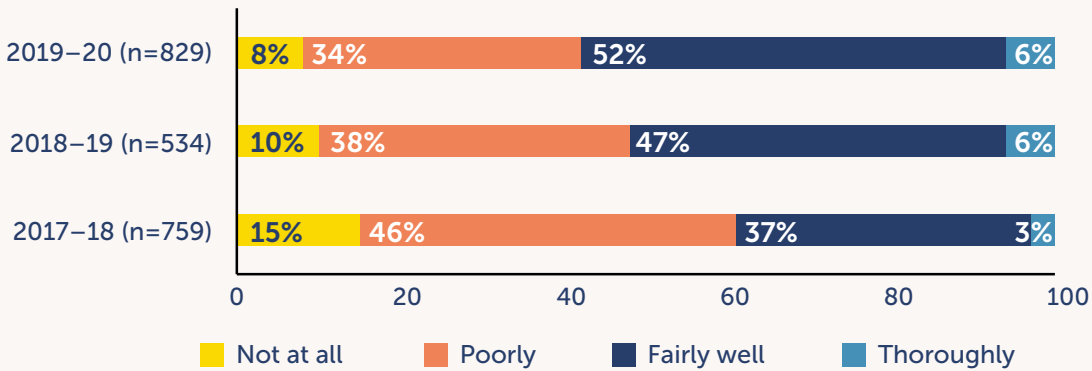
Sources: 2017-18 Survey for K-8 Science Teachers, administered to all expansion teachers in May-June 2018 (N=726); and Early Implementer Spring Surveys, administered to all expansion teachers in May-June 2019 (N=585) and March-April 2020 (N=868).

Figure B2. Expansion teachers' understanding of "the Crosscutting Concepts (CCCs) within the NGSS and how they are used during instruction" in Years 4, 5, and 6 of the Initiative



Sources: 2017-18 Survey for K-8 Science Teachers, administered to all expansion teachers in May-June 2018 (N=726); and Early Implementer Spring Surveys, administered to all expansion teachers in May-June 2019 (N=585) and March-April 2020 (N=868).

Figure B3. Expansion teachers' understanding of "the Disciplinary Core Ideas (DCIs) within the NGSS and how they are used during instruction" in Years 4, 5, and 6 of the Initiative

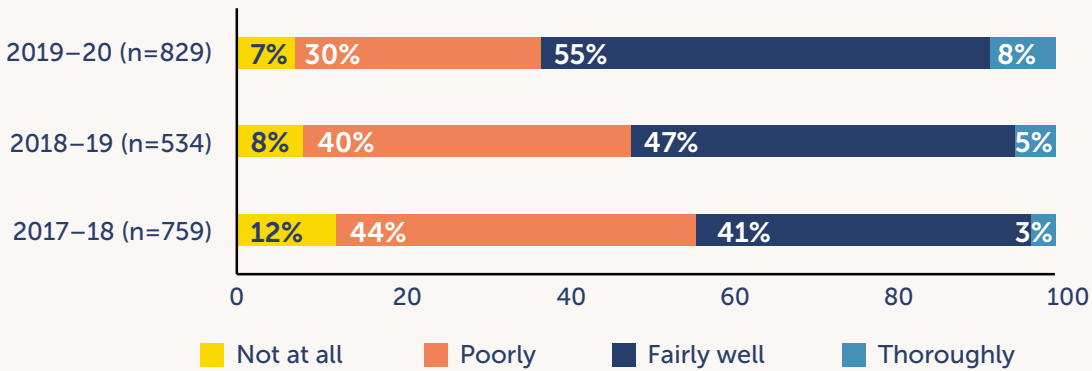


Sources: 2017-18 Survey for K-8 Science Teachers, administered to all expansion teachers in May-June 2018 (N=726); and Early Implementer Spring Surveys, administered to all expansion teachers in May-June 2019 (N=585) and March-April 2020 (N=868).

Almost half (44 percent) of expansion teachers reported already understanding at least "fairly well" how to use engineering design in NGSS instruction in 2018. This grew to 63 percent of

expansion teachers in 2020, with the percent of expansion teachers who reported understanding engineering "thoroughly" more than doubling over the two years (see Figure B4).

Figure B4. Expansion teachers' understanding of engineering design in NGSS instruction in Years 4, 5, and 6 of the Initiative



Sources: 2017–18 Survey for K–8 Science Teachers, administered to all expansion teachers in May–June 2018 (N=726); and Early Implementer Spring Surveys, administered to all expansion teachers in May–June 2019 (N=585) and March–April 2020 (N=868).

Understanding NGSS Teaching

The Initiative provided Early Implementer Teacher Leaders with a variety of tools and practices to support their transition to teaching the NGSS:

- Using science notebooks specifically for student sense-making
- Using 5Es for designing lessons: Engage, Explore, Explain, Elaborate, Evaluate
- Using questioning strategies (e.g., teacher-to-students, student-to-student discourse) to elicit student thinking

- Using Claim, Evidence, and Reasoning (CER) to advance student thinking
- Looking deeply and systemically at students' science work with colleagues

All of the previous tools and practices *except* “Looking deeply and systemically at students’ science work with colleagues” was understood at least “fairly well” by more than half of expansion teachers in 2018, the first year they were surveyed. Only 41 percent of expansion teachers reported understanding this practice “fairly well” or “thoroughly” that year. This increased to more than half (55 percent) in 2020. Systematically reviewing student work with other teachers, which was part of the Early Implementer lesson study,¹² was not a professional learning experience that most expansion teachers had an opportunity to engage in.

¹² See evaluation report #8, *Collaborative lesson studies: Powerful professional learning for implementing the Next Generation Science Standards*. <https://www.wested.org/resources/powerful-professional-learning-for-implementing-the-next-generation-science-standards/>.

Meanwhile, “Using questioning strategies (e.g., student-to-teacher or student-to-student discourse) to elicit student thinking” was consistently the best understood feature. This practice requires that teachers reverse their role in the classroom from what is often referred to as “sage on the stage” (i.e., the teacher provides answers and information to the class) to more of a guide, facilitating student inquiry, discourse, and sense-making. Three-quarters (75 percent) of expansion teachers indicated that they understood this feature of NGSS instruction at least “fairly well” in 2018, and 82 percent did so in 2020.

Not far behind was “Using science notebooks specifically for student sense-making,” which almost two-thirds (64 percent) of expansion

teachers said they understood at least “fairly well” in 2018. The number of expansion teachers who understood the use of notebooks at least “fairly well” increased to 80 percent in 2020, with 20 percent saying they understood their use “thoroughly.”

Expansion teachers also showed growth in how well they understood “The shifts in pedagogy required to teach the NGSS,” with 45 percent in 2018 and 63 percent in 2020 saying that they understood this “fairly well” or “thoroughly.” Taking the knowledge of NGSS pedagogy a step further, 43 percent of expansion teachers said they understood at least “fairly well” “How to help other teachers implement the NGSS.”

Glossary

5E Instructional Model — Based on how people learn (National Research Council, 2000), which says that learners build new ideas on top of old ideas, the 5E instructional model is driven by student questioning and discussion. The five stages of a lesson are Engage, Explore, Explain, Elaborate/Extend, Evaluate.

Anchoring Phenomenon — A phenomenon complex enough to be the focus of an instructional unit lasting multiple weeks or longer. Anchoring phenomena connect to the smaller investigative phenomena that occur at multiple points throughout the unit of instruction.

Claim, Evidence, Reasoning (CER) — CER is based on the NGSS science and engineering practices, primarily engaging in argument from evidence, and has been emphasized as a teaching strategy in Early Implementer training. The three ingredients together help students meet the overarching goals of the NGSS that they develop in-depth understanding of content and develop key skills related to critical thinking and communication.

Core Leadership Team (CLT) — Group of three to five administrators and five to eight teachers established at each district at the beginning of the Initiative. The CLT meets with their Project Director regularly during each school year to plan and lead all Early Implementers Initiative activities. They meet with their K–12 Alliance Regional Director for six Technical Assistance Days each school year.

Core Teacher Leader — Teacher member of the Core Leadership Team. Provides professional

learning to Teacher Leaders, other teachers, and/ or administrators in their district or at projectwide events such as the Summer Institute.

Crosscutting Concepts (CCCs) — One of the three NGSS dimensions and a way of linking the different domains of science. CCCs include patterns; cause and effect; scale, proportion, and quantity; systems and system models; energy and matter; structure and function; and stability and change.

Dimensions of the NGSS — The NGSS includes three dimensions: Disciplinary Core Ideas (what scientists know), Crosscutting Concepts (how scientists make connections among the sciences), and Science and Engineering Practices (what scientists and engineers do, and how scientific knowledge develops).

Disciplinary Core Ideas (DCIs) — One of the three NGSS dimensions. According to National Research Council's Framework for K–12 Science Education, disciplinary core ideas are the important concepts in each of four domains: physical sciences; life sciences; Earth and space sciences; and engineering, technology, and applications of science.

Expansion Teacher — Teacher who has not directly received significant professional learning or support from the Initiative but who is benefiting through the shared expertise of those who have. In larger districts, expansion teachers are typically in schools with at least one Teacher Leader.

Investigative Phenomenon — A phenomenon used as the focus of a learning sequence that helps students develop understanding of scientific

concepts required to understand the larger, more complex anchoring phenomenon.

K–8 NGSS Early Implementers Initiative —

Six-year Initiative (summer 2014 to spring 2020) supporting implementation of the NGSS by eight public school districts and two charter management organizations in California. Developed by the K–12 Alliance at WestEd in collaboration with California State Board of Education, California Department of Education, and Achieve, the Early Implementers Initiative builds capacity of participating local education agencies to fully implement the NGSS in grades K–8.

K–12 Alliance — A WestEd program of science education leaders and professional learning providers who plan and deliver all projectwide activities for the Early Implementers Initiative.

Next Generation Science Standards (NGSS) — A set of K–12 science content standards developed by states to improve science education for all students. They are composed of performance expectations with accompanying three dimensions based on the National Research Council’s Framework for K–12 Science Education. Adopted in California in 2013.

Phenomenon — Natural phenomena are observable events that occur in the universe and that we can use our science knowledge to explain or predict. There are two types of phenomena, anchoring and investigative.

Project Director — District person responsible for leading all Early Implementers Initiative activities for the district and representing the district at monthly Initiative-wide planning meetings with Regional Directors.

Questioning Strategies — Strategies used by teachers to prompt students to discuss and make sense of scientific concepts and phenomena.

Regional Director — Member of WestEd’s K–12 Alliance staff assigned to provide leadership and support to one or two Early Implementers Initiative districts and to meet at monthly Initiative-wide planning meetings with Project Directors.

Science and Engineering Practices (SEPs) —

One of the three NGSS dimensions, SEPs are the behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices that engineers use as they design and build models and systems to solve problems. They include asking questions (for science) and defining problems (for engineering); developing and using models; planning and carrying out investigations; analyzing and interpreting data; using mathematics and computational thinking; constructing explanations (for science) and designing solutions (for engineering); engaging in argument from evidence; and obtaining, evaluating, and communicating information.

Summer Institute — Weeklong professional learning event held every summer to kick off the new Early Implementer school year. Attended by all Initiative participants, some as leaders (Regional Directors, Project Directors, Core Leadership Team members) and others as learners (Teacher Leaders).

Teacher Leader — One of 30–70 teachers in each district who joined the Early Implementers Initiative in year 2, one year after the Core Teacher Leaders. Teacher Leaders attend annual Summer Institutes and participate in two TLCs each school year (one in the fall and one in the spring) and other district-level professional learning.

Teaching Learning Collaborative (TLC) —

Lesson study activity of Years 1 to 4 of the Early Implementers Initiative. Each TLC brings together

three to four same-grade Early Implementers Initiative teachers from different schools within the district. Teachers plan and teach a lesson to two classrooms of students and debrief after each lesson is taught, during which they examine student work from the lesson and redesign the lesson to boost student sense-making. Each Teacher Leader participates in two TLCs per year.

Technical Assistance Day — Meeting of the Core Leadership Team, facilitated by the K–12 Alliance

Regional Project Director, to plan NGSS implementation in the district. Six days per school year.

Toolkit for Instructional Materials Evaluation

(TIME) — A suite of tools and processes for curriculum-based professional learning, designed to help educators evaluate, select, and implement instructional materials aligned to the NGSS. This toolkit is based on the original work of the K-12 Alliance.



Six Years of Scaling Up: Districtwide Implementations of the Next Generation Science Standards

EVALUATION REPORT #12

**Burr Tyler, Ted Britton, Kimberly Nguyen, Denise Estrella, Elizabeth Arnett,
Ashley Iveland, Katy Nilsen**