Developing a Schoolwide Instructional Vision in a STEM School Partnership

Anne Garrison Wilhelm
Southern Methodist University

Jamie D. Gravell
California State University, Stanislaus

Robyn K. Pinilla
Southern Methodist University

Abstract: This article describes an intentionally mutually-beneficial partnership between a university, a local school district, an international company with local presence, and a community to design and create a school focused on STEM education and project-based learning. This article provides a thorough description of the iterative process of establishing an instructional vision, including collecting feedback from all participants, and how the process of establishing an instructional vision supported the creation of the school.

KEYWORDS: instructional vision, school-university partnership, STEM education

NAPDS NINE ESSENTIALS ADDRESSED:
Essential 1: A professional development school (PDS) is a learning community guided by a comprehensive, articulated mission that is broader than the goals of any single partner, and that aims to advance equity, antiracism, and social justice within and among schools, colleges/universities, and their respective community and professional partners.

Essential 2: A PDS embraces the preparation of educators through clinical practice.

Essential 4: Reflection and Innovation—A PDS makes a shared commitment to reflective practice, responsive innovation, and generative knowledge.

Essential 5: A PDS is a community that engages in collaborative research and participates in the public sharing of results in a variety of outlets.

Developing a Schoolwide Instructional Vision in a STEM School Partnership

Common practice in schools and other organizations is to create mission and vision statements to orient shared work. A mission statement describes the purpose of the school or organization and broadly guides decision-making (Boerema, 2006; DuFour et al., 2008). A vision statement, in contrast, describes the ideal future state for the school or organization (DuFour & Eaker, 1998; Gurley et al., 2015). From a strategic planning perspective, the creation and existence of these documents support organizational improvement (Bryson, 2012). It is also well established that a shared vision is necessary for supporting change (e.g., Elmore et al., 1996; Newmann, 1996).

In the context of partnership work, a shared vision is even more important, because each partner enters with varied experiences and expectations. In this paper, we describe work aimed at developing and enacting a shared vision in the context of designing a new prekindergarten (pre-K) through eighth-grade public school focused on STEM. Specifically, we focused on creating an instructional vision to orient our collective work around instruction. An instructional vision is a vision in that it articulates what we are aiming for, and it is instructional in that it focuses on what classroom instruction should look like. Developing an instructional vision and other concrete visions for day-to-day work in schools is not as common a practice as mission and vision statements. However, we argue that instructional vision creation is necessary for supporting improvement work.

The focal partnership between a university, a school district, an international company with a local presence, and a community was established to become a research-practice partnership over an extended time. A research–practice partnership is "a long-term collaboration aimed at educational improvement or equitable transformation through engagement with research" (Farrell et al., 2021, p. 5). The partners quickly agreed that the school should be a "STEM" and "PBL" school, without clear definitions for those terms. As they moved beyond the decision to operationalize those terms, they immediately found the need for a shared instructional vision when discussing what "STEM" or "PBL" would look like in the classroom. For example, some members of the partnership were particularly committed to project-based learning; others were more committed to the problem- or place-based learning structures. There was a need for a concrete set of underlying principles that could unify these different approaches and give the partnership a base of support for moving the work forward—both with respect to teaching and learning, and the adoption of related supports like curriculum materials. The schoolwide instructional vision was intended to support coherence across content areas and orient our collective work as partners designed and opened the school.

Conceptual Frameworks

Coherence

Several scholars in educational leadership and policy have written about the importance of coherence. Some scholars focused on coherence between school and district goals, strategies, and policies (e.g., Cohen et al., 2017; Honig & Hatch, 2004). Other scholars have focused on school-level coherence. For example, Elmore et al. (2014) defined internal coherence as "a school's capacity to engage in deliberate improvements in instructional practice and student learning across classrooms over time, as evidenced by educator practices and organizational processes that connect and align work across the organization" (p. 3). We adopt this internal coherence perspective but acknowledge the importance of also attending to the alignment with external goals (e.g., district expectations around student achievement), strategies, and policies, because they can impact the internal coherence. A key feature of many of these scholars' work is focusing on coherence as a process rather than a state. While some describe coherence as alignment with a focus on the process of "coherence making" (Fullan & Quinn, 2016, p. 30), others describe coherence itself as a process (Honig & Hatch, 2004); in either case, there is a heavy emphasis on the ongoing work involved in building connection and alignment across the organization.

The importance of coherence has largely been demonstrated by how reforms or other initiatives fail to take hold or be sustained when there is a lack of coherence. When schools or districts adopt a new curriculum, the extent to which it is aligned with other initiatives and adequately supported tends to make a big difference (e.g., Coburn et al., 2012; Stein & Coburn, 2008). Further, when one initiative conflicts with another school-, district-, or state-level project, there can be challenges in enacting the initiative. For example, in the Inquiry Hub project, a research–practice partnership between the University of Colorado Boulder and Denver Public Schools, a conflict between instructional innovation and the teacher evaluation system arose (Penuel, 2019). Even though the high school science instructional materials were codeveloped by researchers and school and district staff, when used in classrooms, the partners discovered a lack of alignment between proposed instructional innovations and the teacher observation rubrics. The research–practice partnership team created a crosswalk tool and an accompanying two-page guide to navigate the potential lack of alignment (Penuel, 2019). Instructional innovation likely would be deemed incompatible with teacher evaluation and deprioritized if this lack of alignment were not addressed. Much more generally, there is considerable evidence that alignment between values and activities within schools makes for more effective schools (e.g., Rosenholtz, 1985; Robinson et al., 2017).

Further, researchers have highlighted several fundamental components of schools and districts to support coherence (Elmore et al., 2014; Fullan & Quinn, 2016). One such essential component is leadership for instructional improvement, where principals are expected to share instructional leadership responsibilities with teachers (Elmore et al., 2014). For example, teachers are a part of the decision-making process for the entire school rather than only their singular classroom. A second fundamental component is a school culture of learning and collaboration. Through shared instructional leadership, leaders focus on building a culture of learning and trust, which supports risk-taking and innovation (Bryk & Schneider, 2002; Elmore et al., 2014; Fullan & Quinn, 2016). A third fundamental component is the set of structures and processes for organizational learning and collaboration that allow the culture of learning and collaboration to flourish (Elmore et al., 2014; Honig & Hatch, 2004; Horn & Little, 2010). A fourth fundamental component is a shared understanding of effective practice, which goes beyond a general vision statement that is aspirational and does not provide concrete suggestions for improvement. Instead, a shared understanding of effective practice, or a "shared instructional vision," offers concrete guidance and direction for instructional improvement (Forman et al., 2017; Fullan & Quinn, 2016). The development of a shared instructional vision is the focus of this paper. We further elaborate on the notion of a shared instructional vision in the following section.

Instructional Vision

Forman et al. (2017) described the importance of "developing a vision for the instructional core" (p. 60). For them, and Cohen and Ball (1999), the focus on the instructional core attends to the teacher, student, and content, as well as interdependence between those three. Therefore, a vision for the instructional core is grounded in classroom activity. We call such a vision an instructional vision. Hammerness (2001) studied teachers' "personal" (instructional) visions and described them as "a set of images of ideal classroom practice for which teachers strive" (p. 143). Research has suggested that teachers' instructional visions vary, change over time, and influence teachers' instructional practice (Munter, 2014; Munter & Correnti, 2017). Further, teachers' colleagues can influence their instructional visions (Munter & Wilhelm, 2021). In particular, teachers can be exposed to their colleagues' instructional vision through interactions, which can shape teachers' instructional visions. We expect that many individual teachers have a personal instructional vision that is not necessarily aligned with their school or district instructional vision, especially at the start of a new initiative.

To support coherence in the partnership school, a schoolwide instructional vision was needed. The intent was to use the instructional vision as a shared artifact to guide all instruction and instructional-support decisions in the school planning and implementation. A solid instructional vision based on research and practice could serve an initial purpose and then continue to evolve as the teachers, and school leaders, took it up in the school (Forman et al., 2017). Regardless of whether the vision looked the same as what we had developed initially, the practice of starting with a shared vision and continuing to use a standard, prominent, and instruction-focused vision for teacher and leader decision-making allows for the continued development of a shared instructional vision over time.

Goals for Student Learning in Math and Science and for Project-, Problem-, and Place-Based Learning

Given the agreed-upon STEM and PBL focus for the school, the project began by identifying clear goals for students' learning. Based on institutional constraints, project partners knew that students would have different mathematics, science, English language arts, and social studies time allocations rather than integrated cross-curricular periods. In turn, they were not necessarily focused on integrated STEM but instead on what innovative instruction looks like across the science, technology, engineering, and mathematics (STEM) disciplines and, hence, focused on ambitious goals for student learning in science and mathematics as a foundation for the instructional vision.

Science

The *Framework for K-12 Science* (National Research Council [NRC], 2012) describes three dimensions of science and engineering education in which students should have knowledge and understand the practices of by high school completion. The first dimension, called *practices*, outlines the investigative behaviors of scientists and design procedures that engineers apply as deeper capabilities than knowledge or skills alone. This dimension stresses student engagement in science and engineering education for direct experience in learning as important ways for students to develop the cognitive, social, and physical application that inquiry learning necessitates. The second dimension, called *crosscutting concepts*, links the practices shared by science disciplines to concepts and processes across scientific domains. For instance, those links include patterns, similarities, and differences; these concepts may be juxtaposed and interrelated for students to develop organizational schemas in their thinking and knowing. Crosscutting concepts relates to the third dimension, called *disciplinary core ideas*, to propel such learning into classrooms. This dimension stipulates that core ideas should have broad importance or serve as crucial organizing concepts; provide tools to understand and investigate complex ideas or problems; relate to students' personal or societal concerns; and be teachable as integrated with engineering, technology, and the application of science. By attending to these domains together, the practices, crosscutting concepts applicable to and linking all scientific disciplines, and core ideas can be woven together as dimensions through which high-quality science instruction occurs.

Mathematics

In mathematics, two complementary frameworks describe ambitious goals for student learning: the Five Strands of Mathematical Proficiency (NRC, 2001) and the *Principles and Standards for School Mathematics* (National Council of Teachers of Mathematics [NCTM], 2000). The Five Strands of Mathematical Proficiency are five components believed to be necessary for individuals to successfully learn mathematics: (a) conceptual understanding, (b) procedural fluency, (c) strategic competence, (d) adaptive reasoning, and (e) a productive disposition (NRC, 2001). These strands are depicted as a rope to illustrate their interdependent nature as individuals develop mathematical knowledge, skills, abilities, and beliefs (NRC, 2001).

The NCTM (2000) standards describe Content and Process Standards as a set of learning goals for mathematics. The Content Standards include five interrelated content strands: Number and Operations, Algebra, Geometry, Measurement, and Data Analysis and Probability. The Process Standards include five "ways of acquiring and using content knowledge" (NCTM, 2000, p. 29): (a) problem-solving, (b) reasoning and proof, (c) communication, (d) connections, and (e) representations.

PBL

Whereas PBL is commonly associated with student-centered or inquiry-based learning, different individuals in the partnership had varying notions of what the "P" in PBL stands for. Problem-, project-, and place-based learning are instructional approaches that have gained traction in K-12 education and were possibilities they wanted to allow for within the instructional vision development. The project team entered the development phase with a generic view of PBL to provide the opportunity for the community, corporate partner, district, and university stakeholders to meld their conceptions into a single vision within a larger instructional framework. Next, we briefly review the three instructional approaches and describe their differences to lay a foundation for how they can be coherently interwoven into a schoolwide instructional vision.

Project-based learning is typically associated with a product, whereas problem-based learning is the process of creatively solving ill-defined problems. Both project- and problem-based learning share origins in the work of Dewey and Kilpatrick in the early 20th century (Savery, 2015) but were fully articulated in the 1950s and 1960s. Developed in schools of medicine seeking to promote more complex problem-solving capabilities in students (Barrows, 1996), problem-based learning poses challenges to students that do not have a formulaic path to a single solution. Defining features of problem-based learning, such as student-centered learning and the problem forming the organizing focus or stimulus (Barrows, 1996), are closely mirrored through current frameworks for project-based learning (Dean et al., 2016). Project-based learning refers to teaching methods through which students engage for an extended time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge (Larmer, 2020). Dean et al. (2016) contended that the overlaps between problem-based and project-based learning make differentiating them difficult and questioned the cost-benefit of adopting one over the other.

Place-based learning, also called place-conscious education (Gruenewald, 2003) and community-oriented schooling (Theobald & Curtiss, 2000), might be more distinct from the other "Ps" but was important to the partnership, as they sought to provide authentic learning experiences in a particular community. Place-based learning seeks to break down the isolation of education as occurring within the school walls to extend practice and pedagogy toward local contexts, honoring students' real-life experiences, and centering the community (Gruenewald, 2003). However, scholars are increasingly identifying educational institutions as promoting placelessness through standardized educational environments and curricula that disregard the connection between people and place (Augé, 2008; Bertling, 2018).

Counter to this globalization narrative, the partnership chose to situate its instructional vision within its locale. Commitments to problem-, project-, and place-based instruction and the strong focus on STEM helped the project partners identify relevant frameworks as they sought to inductively build a schoolwide instructional vision to support coherence-making.

Context

The Neighborhood STEM School (NSS, a pseudonym) is a pre-K through eighth-grade community school in a large, urban public school district in the southwestern United States, in a state that has not adopted the Common Core State Standards (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010). A local university received a 3-year planning grant from an industry partner to facilitate the development of the school ahead of the opening of the school for seventh and eighth graders. In the year following the seventh- and eighth-grade opening, the school would open for pre-K through first-grade and grow with the younger children each year. Additionally, the NSS would continue to have students from other feeder pattern elementary schools in the large, public school district join the school community in seventh grade every year.

The NSS is a partnership among the school district, the university, the industry partner, and the community, and the design of the planning activities was intended to represent that partnership. For example, decisions were made with representatives from each partner but often led by the university due to the funding and time allocations. Because of the grant, the university had more time to devote to project planning activities. Other critical partners were nonprofit organizations working as wrap-around service providers (e.g., afterschool programs, tutoring programs) in the community, who would serve an important formal role in the community school.

The project partnership was organized into a set of design teams to support the planning activities. The work to develop the NSS instructional vision was at the intersection of two design teams: (a) Instructional Innovation and Equity and (b) Professional Learning and Distributed Leadership. To summarize, the work was led by two members of the university team (the university leads) and involved members from all four project partners (community, district, industry partner, and university) who were jointly planning for the curriculum, instruction, professional learning, and leadership within the school.

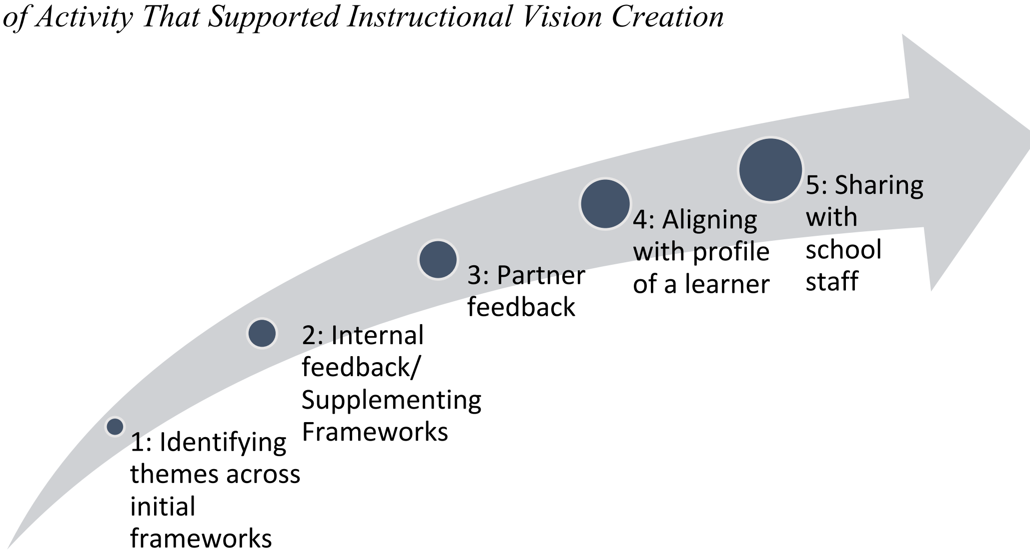
Core decisions related to the instructional vision, described in greater detail above, were the STEM emphasis in the school and the flexible definition of PBL. Another crucial contextual element is that the industry partner was funding this project to develop a model for STEM school development in the focal community and other communities. The emphasis on a replicable model had implications for their approach to planning. For example, the adopted curriculum materials had to be open source to be financially easy to adopt in other contexts. Some initial curriculum work involved creating project-based and place-based learning units, which helped the university team quickly see that they did not have the capacity to develop a comprehensive curriculum for the NSS. Therefore, they had to supplement what was created with existing open-source curriculum materials, and they needed a set of criteria for deciding which curriculum materials to use. Given the scope of the project and the importance of coherence, they needed a common framework that would help guide the project work around matters of curriculum and instruction.

The project team set out to create a framework that could be used as the instructional vision for the NSS. They intended for it to be immediately helpful for both supporting curriculum adoption and developing teacher professional learning and instructional leadership routines. Ahead of the opening of the school, the university team designed professional development intended to introduce teachers to the NSS instructional vision, both generally and within teachers' specific content areas.

Data, Analysis, and Results

The university leads engaged in an iterative process of pulling together several frameworks, inductively coding to extract themes from the different frameworks (Ravitch & Carl, 2015), and seeking repeated feedback from other partnership members. To avoid redundancy, in what follows, we describe the data, analysis, and results at each stage of the project, describing their results before moving on to the next step. We use these rounds to organize the different activities and related revisions as iterations on the development. In total, there were five distinct rounds of activity, with related revisions to the instructional vision framework (see Figure 1).

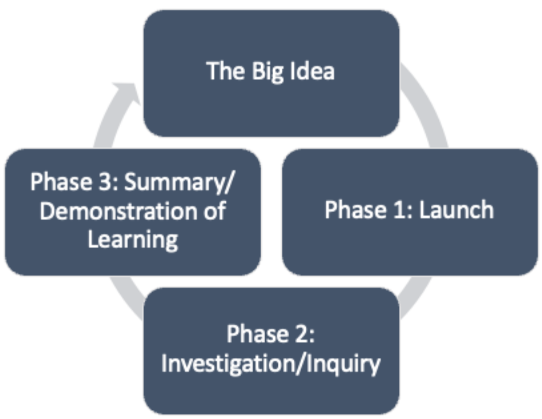
Figure 1
Rounds of Activity That Supported Instructional Vision Creation



Rounds 1 and 2 of NSS Instructional Vision Development

The two university leads engaged in an affinity grouping exercise (Hanington & Martin, 2017), pulling and grouping different dimensions from four foundational frameworks—Ambitious Science Teaching (Windschitl et al., 2018), Mathematics Teaching Practices (NCTM, 2014), a Project-Based Learning checklist, and the district instructional framework—described in greater detail below. With an overarching orientation toward ambitious problem-, project-, or place-based instruction, the university leads first organized the affinity grouping exercise around a common unit and lesson structure in inquiry-based teaching: a launch-explore-summarize format. They added on a fourth structural category corresponding to the big idea for the unit, for aspects that did not conform to one phase within the lesson or unit. This process resulted in four overarching structural categories: (a) the Big Idea, (b) Phase 1: Launch, (c) Phase 2: Investigation/Inquiry, and (d) Phase 3: Summary/Demonstration of Learning (see Figure 2). These categories roughly mapped onto phases of units or lessons, with the "Big Idea" category being more closely related to planning or design, the Launch related to introducing the activity or unit, the Investigation/Inquiry phase being about exploration, and the Summary phase focusing on demonstration or consolidation of learning.

Figure 2
Four Structural Categories for Themes in Round 1



Given the adopted emphasis on STEM, the university leads began by identifying Ambitious Science Teaching (AST; Windschitl et al., 2018) and the Mathematics Teaching Practices (MTP; NCTM, 2014) as frameworks for high-quality science and mathematics teaching. The AST model (Windschitl et al., 2018) was developed out of a desire to provide teachers with more concrete suggestions for high-quality teaching in science, consistent with the NRC framework. The AST model consists of a set of practices that encourage teachers to develop a shared language about their common, ambitious instructional practices geared toward intellectual engagement and attention to equity. Windschitl et al. asserted the principle of equity as meaning that teachers provide opportunities for all students to "take advantage of situations that are designed to support learning" (p. 12). Through that equity principle, teachers can cohesively utilize the four AST practices: (a) plan for student engagement using the big ideas, (b) elicit student ideas, (c) support students' continually changing ways of thinking, and (d) draw together evidence-based explanations (Windschitl et al., 2018).

In 2014, the NCTM published the eight MTP, which constitute a framework that illustrates "a core set of high-leverage practices and essential teaching skills necessary to promote deep learning of mathematics" (NCTM, 2014, p. 9). Those practices include the following (NCTM, 2014, p. 10):

- Establish mathematics goals to focus learning.
- Implement tasks that promote reasoning and problem-solving.
- Use and connect mathematical representations.
- Facilitate meaningful mathematical discourse.
- Pose purposeful questions.
- Build procedural fluency from conceptual understanding.
- Support productive struggle in learning mathematics.
- Elicit and use evidence of student thinking.

The MTP were designed to improve the teaching and learning of mathematics for all students, in accordance with the NCTM process standards. Specifically, the MTP aimed at strengthening productive beliefs around the teaching and learning of mathematics for all students and sought to eliminate the persistent opportunity gaps related to race, ethnicity, and socioeconomic status (NCTM, 2014). Improving teaching and learning for all students connects with the equity component of the *Framework for K-12 Science* (NRC, 2012) and principles within the AST (Windschitl et al., 2018).

The team next added the design checklist for the project-based learning units and the district's overarching framework for high-quality instruction. The PBL unit design checklist was created by experts in PBL on the curriculum team and had four top-level categories of design elements: (a) standards and skills driven; (b) community context and relevancy; (c) supportive, responsive culture; and (d) assessment practices. Each of these had four or more bullets that specified features of PBL units. Finally, the district's learning framework was created as part of a strategic planning effort to create a vision for the district's learning, technology, and facilities design. The district's learning framework included six dimensions: (a) inspire: motivate and inspire the learner; (b) aim: define goals and develop a plan for success; (c) explore: seek new knowledge through productive struggle; (d) create: develop and validate flexible, novel solutions, (e) apply: deploy knowledge and skills to relevant situations; and (f) reflect: pursue constructive feedback with a focus on goal progression.

These four frameworks (AST, MTP, PBL checklist, and district framework) representing STEM, project-based learning, and high-quality instruction in the school district formed the foundation of the instructional vision. The university leads approached the affinity grouping exercise by pulling different dimensions from the frameworks and grouping them with similar ideas from other frameworks. The four overarching structural categories in Figure 2 served as the backbone for this round of affinity grouping. Within these categories, they examined the dimensions from the frameworks to pull out themes. Rather than trying to identify themes that were most often common across frameworks, they identified themes in a manner that represented the *breadth* of each framework. They wanted to ensure that everything within each framework was represented within their emerging instructional vision.

The second round involved meeting with internal university staff members of the NSS project team who were also familiar with high-quality teaching in STEM or project-based learning. The university leads made some changes to the language of the themes to address their feedback. They also expanded their reading and coding to include two additional frameworks, one that they were already planning to add to attend to place-based education more explicitly (i.e., culturally sustaining pedagogy; California Department of Education, 2022; Paris, 2012), and one that was recommended to address some holes identified by university partners in their initial draft, the

Science Teachers Learning from Lesson Analysis (STeLLA) two-lens framework of strategies for effective science teaching (Roth et al., 2017).

The culturally sustaining pedagogy framework builds upon asset-based pedagogies, including culturally relevant (Ladson-Billings, 1995) and culturally responsive (Gay, 2018) pedagogies, to view schools as places in which cultural ways of being can be sustained in communities of color (California Department of Education, 2022). Utilizing this framework allowed the team to focus on teachers' and students' cultures and contexts as assets for learning. The STeLLA two-lens framework was selected to round out some perceived holes with respect to effective science teaching, particularly around lesson and unit coherence (Roth et al., 2017). In that framework, the two lenses are student thinking and science content storyline. Further, within the science content storyline lens, the emphasis is on strategies to create a coherent science content storyline.

The results from Rounds 1 and 2 are summarized in Table 1. The team identified 20 themes across the four initial frameworks, which formed Round 1. An "X" in a given cell indicates a connection between a dimension within the existing framework and that theme. As an example, we have mapped the dimensions to emergent themes for just the last category (i.e., Phase 3: Summary/Demonstration of Learning) in greater detail in Figure 3. This mapping was done for each of the categories, but we have only included one such mapping as an example. In Figure 3, the top four groups of phrases correspond to the relevant pieces of the four frameworks used in Round 1. For example, students' ideas being represented publicly and worked on by the class is part of the AST framework and is related to the themes of "share understandings or products" and "authentic contribution to a community of practice." The right two columns of Table 1 represent the two additional frameworks added in Round 2. The two additional frameworks had dimensions related to a number of the 20 themes identified in the first round, but also surfaced four different themes that were important to the NSS instructional vision: (a) driven by what the community wants to sustain or change, (b) coherence, (c) building on what children already know, and (d) teacher investigates children's learning.

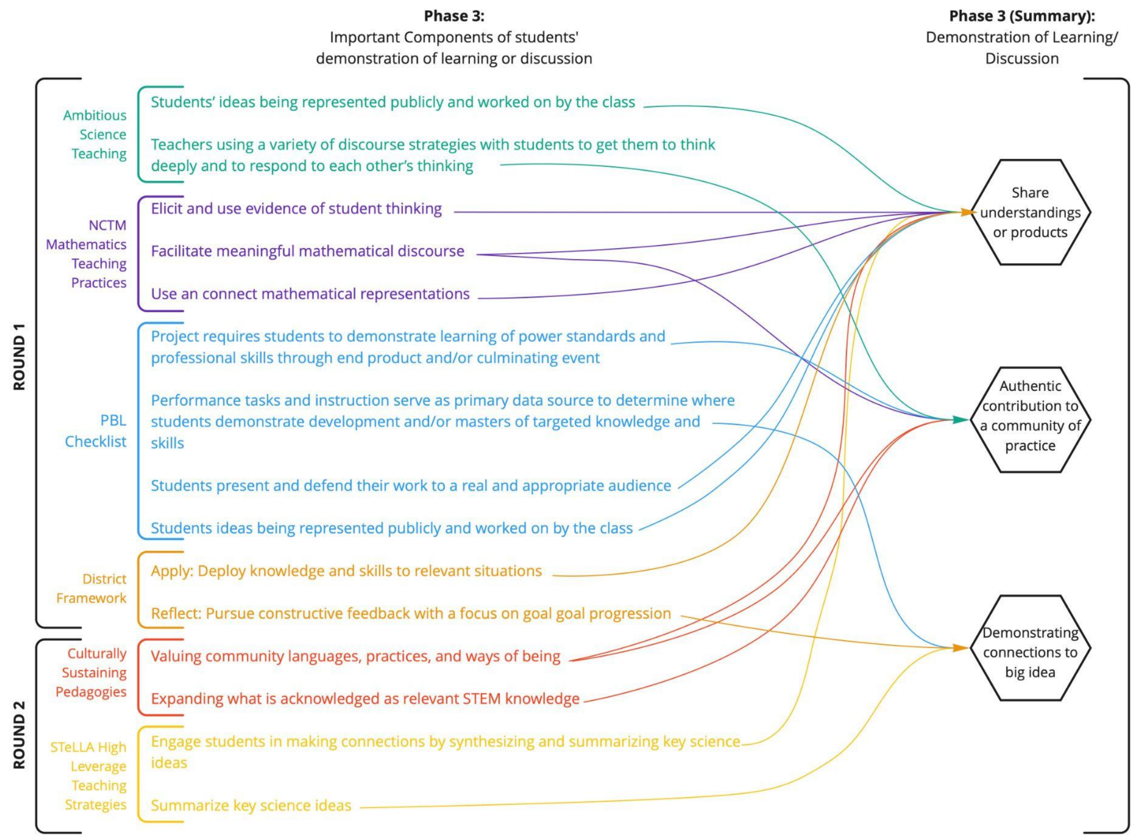
Figure 3 is intended to exemplify the mapping of ideas from frameworks to the emerging NSS instructional vision themes as we transitioned from Round 1 to Round 2, focusing on one structural category within the emerging vision, Phase 3: Summary/Demonstration of Learning. For example, Figure 3 illustrates how dimensions from all six frameworks related to the theme "share understandings or products," indicated by the arrows from at least one dimension of each framework to that theme in the top hexagon. The other two themes in the Phase 3 category, represented by the bottom two hexagons, were also aligned with dimensions of a number of the six frameworks.

Table 1
Coding Summary of Themes Mapped to Frameworks

Themes	Round 1				Round 2	
	PBL	MTP	AST	District	CSP	STeLLA
The Big Idea/Enduring Understanding/Purpose of Unit						
Driven by big ideas/enduring understandings	X	X			X	
Driven by what the community (including students) wants to sustain/change					X	
Expansive definition of STEM (and other disciplines)	X	X			X	
Coherence						X
Connected to content and process standards	X					
Developmentally appropriate expectations for students	X					
Phase 1: Launch						
Authentic connections to the world and/or discipline	X		X			
Building on what children already know					X	
Clear goals		X	X			X
Student voice and agency	X				X	
Sparks interest and curiosity	X	X		X		
Phase 2: Investigation/Inquiry						
Students engage in an iterative sensemaking process	X	X	X	X	X	X
Modeling and representations	X	X	X	X		X
Collective understanding		X	X			
Discourse	X	X	X		X	X
Student-driven decision-making/next steps	X		X	X	X	
Ongoing assessment	X					
Consulting experts	X					
Scaffolding			X			
Foregrounding big idea before the details/practice		X				X
Teacher investigates children's learning					X	
Phase 3: Summary/Demonstration of Learning						
Share understandings or products	X	X	X	X	X	X
Authentic contribution to a community of practice	X	X	X		X	
Demonstrate connections to big ideas	X			X		X

Note. PBL = problem-, project-, and place-based learning. MTP = Mathematics Teaching Practices. AST = Ambitious Science Teaching. CSP = culturally sustaining pedagogy. STEM = science, technology, mathematics, and engineering.

Figure 3
Example: Phase 3 Mapping of Dimensions of Six Frameworks to Related Themes



Note. Arrows from the frameworks to the emerging themes (in hexagons) indicate alignment.

Round 3 of NSS Instructional Vision Development

In Round 3, the draft of the instructional vision that followed from Rounds 1 and 2 was then shared with a larger group of NSS project team members representing all of the different project partners in two other feedback sessions. People from all four project partners who were members of the Instructional Innovation and Equity and Professional Learning and Distributed Leadership design teams were invited to provide feedback at this stage of the process. They used the Constructivist Tuning Protocol (School Reform Initiative, 2021) and walked them through the four structural categories of the vision to elicit what people liked, what they needed more information about, and what they feared might be missing, walking them through the four structural categories of the vision.

The feedback the university leads received in Round 3 from multiple feedback sessions with representatives from different project partners focused on several different features, including three improvements needed: (1) making the language resonate with disciplinary communities other than science and mathematics; (2) supporting teachers to enact this vision in a district heavily focused on teaching the state-adopted content standards; and, (3) condensing it to be more manageable for teachers. The university leads took this feedback into Round 4, which involved addressing the feedback from the larger project team while also checking for alignment with another key project tool, the Profile of a Learner.

Round 4 of NSS Instructional Vision Development

Although the focus of this paper is the instructional vision, a critical and parallel planning activity was the development of the Profile of a Learner (see Table 2). Similar to the vision development, the development of the Profile of a Learner was iterative and sought input from representatives of each project partner.

The task of aligning the instructional vision with the Profile of a Learner helped the university leads to see that they could streamline the instructional vision by moving away from the four categories they initially used (represented in Figure 2) to three different categories, the first two of which were focused on the student experience and one focused on designing for learning (see Table 3). The two main categories for the student experience were (a) teachers balance student agency and learning goals and (b) teachers facilitate student engagement in an iterative sensemaking process. The themes underneath those headers in Table 3 further flesh out those categories. To continue the example description of the evolution of themes that began in Figure 3, several of the themes were moved into the category pertaining to designing for learning and reworded as "contributing to a community of practice" and "demonstrating connections to big ideas." The "share understandings or products" theme was removed because it was represented in several others, including utilizing discourse, developing and revising models and representations, and working toward collective understanding, all within the category of "teachers facilitate student engagement in an iterative sensemaking process." Other themes outside of the scope of the example in Figure 3 were added as well, including "embracing productive struggle," to more visibly connect to the profile of the learner and the mathematics teaching practices, as well as others.

Table 2
Neighborhood STEM School Profile of a Learner

Broad idea	Selected examples
Critically conscious & culturally competent	· Value their own backgrounds and identities with confidence that their school values these as well (including students' full linguistic repertoires). · Seek to learn about other people and cultures and exhibit cultural humility. · Dream big and advocate for themselves, their peers, and their communities in order to pursue goals/visions for the future.
Engagement in authentic scholarship	· Ask and pursue answers to researchable questions or problems. · Consider problems in context. · Follow a clearly articulated problem-solving process to methodically gather, critique, and analyze information. · Engage in discipline-specific modes of epistemic reasoning to create and refine knowledge claims (e.g., students engage in scientific, mathematical, or historical reasoning rather than simply learning the content knowledge of these disciplines).
Confident and persistent	· Dream big: aspiring to lofty, impossible dreams and identifying barriers that stand in the way of those dreams as well as resources and sources of assistance that can facilitate overcoming such barriers. · Actively encourage (and be encouraged by) peers to take intellectual risks. · Identify stumbling blocks, assess needs for support, and learn from failure.
Effective collaborator	· Collaboratively set long- and short-term goals. · Recognize and value collaborators' strengths and contributions. · Give and receive meaningful feedback, carefully considering the thoughts of others before critiquing them.
Effective communicator	· Engage in perspective-taking to understand stakeholders' values, communicate one's own values, and build a shared sense of ownership in desired outcomes. · Engage in effective written, spoken, or visual communication (including email) for a variety of audiences and purposes, and draw on wide linguistic repertoires (i.e., multiple languages, dialects, or registers).

Note. Truncated from *A Shared Vision: Applications of WDSS Instructional Vision and Learner Profile*, by J. Gravell and Q. C. Sedlacek, 2021, presentation at Caruth Institute for Engineering Education Friday Research Talk Spring Conference, Southern Methodist University, Dallas, TX.

Table 3
Neighborhood STEM School Instructional Vision

Category	Themes
Teachers balance student agency and learning goals	• Creating space for student voice • Articulating clear goals for learning • Sparking interest and curiosity • Expecting what is developmentally appropriate
Teachers facilitate student engagement in an iterative sensemaking process	• Working toward collective understanding • Building on what children already know • Embracing productive struggle • Utilizing discourse • Developing and revising models and representations • Intentionally consulting others • Assessing in an ongoing manner • Scaffolding
Teachers design for learning driven by big ideas, enduring understandings, and what the community wants to sustain or change	• Contributing to a community of practice • Promoting an expansive view of disciplines • Emphasizing coherence • Valuing and designing for variation • Fostering authentic connections • Driven by what the community wants to sustain or change • Driven by big ideas/enduring understandings • Demonstrating connections to big idea

Round 5 of NSS Instructional Vision Development

To prepare for the instructional vision to be used as a guiding document with teachers and school leaders, the university leads created a version with descriptors for each of the themes and used this document to share the vision with school leaders and teachers. These descriptors are represented in the second column of Table 4; the first column of maps onto the themes listed in Table 3.

Table 4
School Staff-Facing Version of Neighborhood STEM School Instructional Vision

Theme	Descriptor
Teachers balance student agency and learning goals	
Creating space for student voice	Teachers engage in routines and structures that require student input on direction of learning and outcome of learning. Students authentically contribute to the learning agenda.
Articulating clear goals for learning	Everyone in classroom community knows the purpose and plan for the day and how it connects to the larger learning/project goals and Texas Essential Knowledge and Skills.
Sparking interest and curiosity	Instruction is focused on questions rather than absolutes. Students are encouraged to ask questions and focus on aspects of the subject that especially interest them. Learning connects with lived experience as identified by students and adults.

Theme	Descriptor
Expecting what is developmentally appropriate	Students engage in roles, routines, and procedures that are developmentally appropriate to allow for complex knowledge building. Supports are available, but students are not restricted from attempting complex work due to age or reading level.
Teachers facilitate student engagement in an iterative sensemaking process	
Working toward collective understanding	Teachers and students work to build a shared understanding by engaging in conversations and collaborative, iterative refinements of group and individual ideas.
Building on what children already know	Teachers approach student contributions as connected, important, and containing understandings to build upon and integrate with new information rather than something to be fixed.
Embracing productive struggle	Classroom activity requires students to engage in collaborative, complex knowledge building. Teachers utilize activities that will build on what students know and are able to do yet require perseverance in achieving the goal.
Utilizing discourse	Teachers use a variety of discourse strategies to encourage students to think deeply and to respond to each other's thinking. Students have small-group and whole-class opportunities for discussion with peers. Students prompt each other to engage in sensemaking talk during investigations and other activities.
Developing and revising models and representations	Teachers identify representations and models aligned with the learning goal and facilitate classroom activity around those representations and models. Students engage in rounds of developing, using, and connecting representations and models.
Intentionally consulting others	Teachers and students decide when they need to draw on others' expertise based on their progress toward their goal(s). This can include teacher lecture, consulting disciplinary experts, students sharing their expertise and experience, consulting texts, etc.
Assessing in an ongoing manner	Teachers use a range of evidence (e.g., students' work, talk, demonstrations of learning) to understand students' thinking and use those understandings to design instruction and scaffold learning for individual learners. Students have opportunities to receive feedback, revise work, and reflect on their progress.
Scaffolding	Teachers utilize appropriate supports for students to meaningfully participate in class activity.
Teachers design for learning driven by big ideas, enduring understandings, and what the community wants to sustain or change	
Contributing to a community of practice	Students are engaged in the work of the field in which they study—rather than receptacles of knowledge, they are participants in the work of that field as an apprentice rather than expert.
Promoting an expansive view of disciplines	Teachers value everyday science and math, tinkering, traditions of speech and oral literacy/history, and current cultural ways of knowing.
Emphasizing coherence	Teachers develop a plan for instruction that predicts possible hiccups or misunderstandings while signposting places to return to the learning goal path.
Valuing and designing for variation	Classroom activities allow for and encourage variation in activities and products.
Fostering authentic connections	Students can articulate how their classroom work represents or relates to the world or work of experts in their field of study.
Driven by what the community wants to sustain or change	Leaders, students, and teachers investigate student, family, and communities to understand what is valued to be sustained and what is identified by the community as in need of change.
Driven by big ideas/enduring understandings	Important conceptual ideas from content areas are the driving force behind instructional planning and in-the-moment classroom instruction.
Demonstrating connections to big idea	Teachers make connections for students and facilitate student's own connections from their experiences in class to the enduring understandings/big ideas.

The goal of Table 4 was to provide concrete but concise elaboration of each theme with explicit attention to describing the range of what counts for that theme. After experiencing the instructional vision through content-area activities and discussions, the university leads administered a survey that asked teachers to review the instructional vision document and rate the clarity and confidence related to each aspect. In particular, they asked (a) "To what extent is this aspect clear to you?" and (b) "To what extent are you confident enacting this in your classroom?" The 4-point Likert scale ranged from 1 (*not at all clear/confident*) to 4 (*very clear/confident*). Other responses were 2 (*a little clear/confident*) and 3 (*somewhat clear/confident*). Ten (of 20) members of the school staff consented to having their responses used as part of this research. Participants were mostly teachers (including math, social studies, art, English language arts, and special education), but also included one school leader. Table 5 summarizes results from the survey for those 10 staff members.

Table 5
Neighborhood STEM School Staff Survey Results

Theme	Clarity			Confidence			Diff.
	Obs.	*M*	*SD*	Obs.	*M*	*SD*	*M*
Creating space for student voice	10	3.90	0.32	9	3.67	0.50	0.33
Articulating clear goals for learning	10	3.80	0.42	9	3.67	0.50	0.22
Sparking interest and curiosity	10	3.80	0.42	9	3.33	0.50	0.56
Expecting what is developmentally appropriate	10	3.30	0.48	9	3.22	0.44	0.11
Working toward collective understanding	10	3.70	0.48	10	3.40	0.52	0.30
Building on what children already know	10	3.90	0.32	10	3.70	0.48	0.20
Embracing productive struggle	10	3.60	0.52	10	3.30	0.82	0.30
Utilizing discourse	10	3.80	0.42	10	3.70	0.48	0.10
Developing and revising models and representations	10	3.60	0.52	10	3.30	0.67	0.30
Intentionally consulting others	10	3.20	0.63	10	2.90	0.57	0.30
Assessing in an ongoing manner	10	3.60	0.52	10	3.50	0.71	0.10
Scaffolding	10	3.70	0.48	10	3.70	0.48	0.00
Contributing to a community of practice	10	3.50	0.71	10	3.20	0.79	0.30
Promoting an expansive view of disciplines	10	3.70	0.48	10	3.20	0.79	0.50
Emphasizing coherence	10	3.50	0.71	10	3.30	0.67	0.20
Valuing and designing for variation	10	3.60	0.70	10	3.30	0.67	0.30
Fostering authentic connections	10	3.70	0.67	10	3.50	0.53	0.20
Driven by what the community wants to sustain or change	10	3.00	0.82	10	3.10	0.74	-0.10
Driven by big ideas/enduring understandings	9	3.44	0.53	9	3.56	0.53	-0.11
Demonstrating connections to big idea	9	3.33	0.50	9	3.44	0.53	-0.11

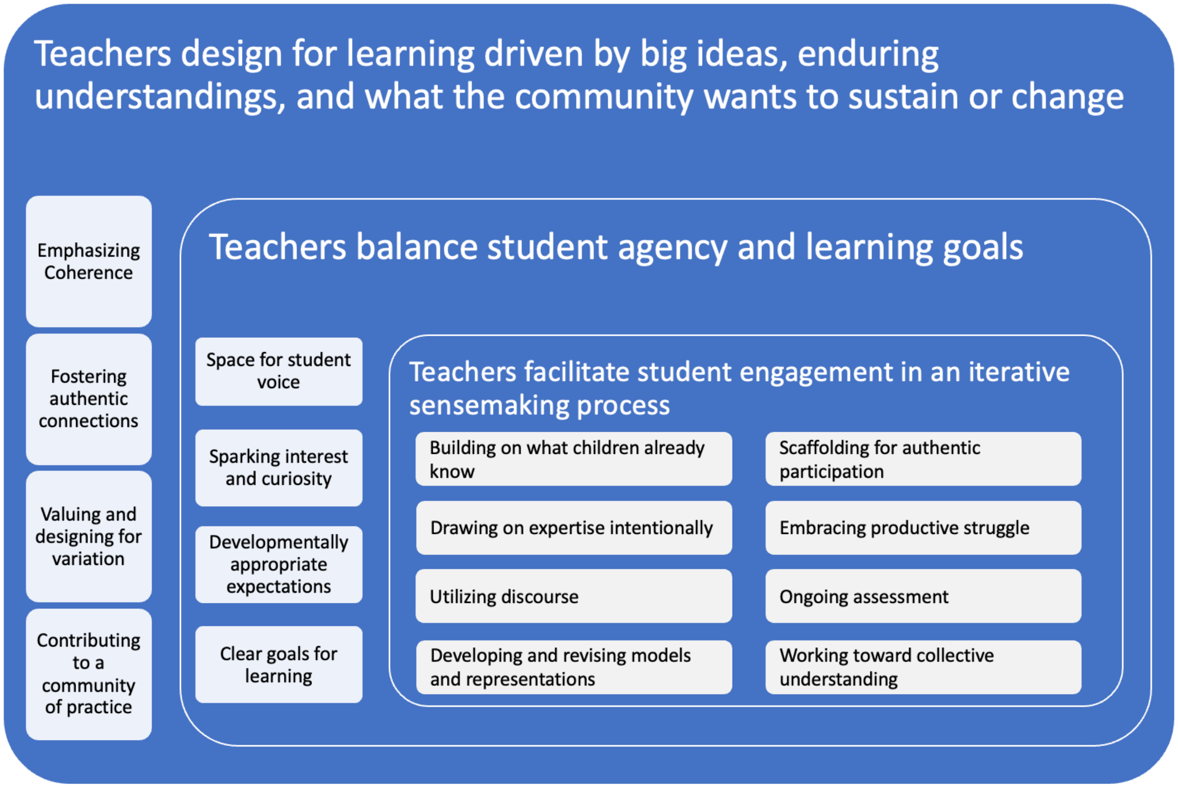
Note. Scores based on a scale of 1 (*not at all clear/confident*) to 4 (*very clear/confident*).

A few themes (i.e., aspects) stood out as less clear to NSS staff, with a mean value corresponding to a response near *somewhat clear* rather than *very clear*. Those themes were "intentionally consulting others" (*M* = 3.2) and "driven by what the community wants to sustain or change" (*M* = 3). In general, clarity and confidence appear to be related, with lower scores on clarity corresponding to lower scores on confidence. Further, teachers generally rated the clarity of the statement higher than their confidence in enacting it in the classroom. To control for the potential lack of clarity in the description influencing teachers' confidence, and to surface additional themes that teachers were less confident in enacting, we subtracted a teacher's score for confidence from a teacher's score for clarity to create a difference score (see the last column in Table 5). Two themes stand out as practices that teachers found clear, yet were less confident in how to enact them: "sparking interest and curiosity" (*M* difference = 0.56) and "promoting an expansive view of disciplines" (*M* difference = 0.50). Also of note are several themes for which teachers actually rated their confidence higher than the clarity of the description: "driven by what the community wants to sustain or change" (*M* difference = -0.10), "driven by big ideas/enduring understandings" (*M* difference = -0.11), and "demonstrating connections to big ideas" (*M* difference = -0.11).

Overall, teachers seemed to think that the descriptions of the instructional vision were clear and that they were somewhat confident or very confident in enacting them in the classroom. However, following the survey-based feedback and professional development sessions with school staff, the university leads made a few minor changes to the organization of the instructional vision and the wording of categories and themes (see Figure 4). For example, they changed "intentionally consulting others" to "drawing on expertise intentionally." Another significant change was to move the two themes related to what drives instruction (e.g., "driven by what the community wants to sustain or change") into the category title for instructional design, rather than having them stand alone as separate themes. This move of the themes to the header was intended to indicate their centrality within decision-making and makes it more parallel with the category describing iterative sensemaking for students.

The resulting instructional vision (see Figure 4) has three nested categories: instructional design at the outermost level, teachers' goals and orientations at the next level, and students' experiences at the innermost level. At the outer level is the category entitled "teachers design for learning driven by big ideas, enduring understandings, and what the community wants to sustain or change." At the middle level is the category named "teachers balance student agency and learning goals." The innermost level holds the category "teachers facilitate student engagement in an iterative sensemaking process."

Figure 4
Neighborhood STEM School Instructional Vision



The intention was for the instructional vision to be revised over time as the school staff collectively make sense of it together. However, based on the iterative process they undertook and the feedback from school staff, the university leads are optimistic that the instructional vision, in its current and future forms, has the potential to support teachers as they make changes to their instructional practice in support of the student learning goals outlined in the Profile of a Learner.

Discussion

This article describes the effort to design an instructional vision in the context of a school-university partnership that also included partners from a corporation and the community. The project team set out to support a coherent focus on ambitious and equitable teaching practices across disciplines in a new public community school with a STEM focus, in order to support both teacher inquiry and student learning. This task involved an iterative process centered on bringing together existing frameworks for ambitious and equitable instruction across disciplines and incorporating partner feedback. The process resulted in an instructional vision emphasizing inquiry-based instruction, allowing for problem-, project-, and place-based instruction. In particular, the resulting product, the NSS instructional vision (see Figure 4), has three nested categories: (a) teachers design for learning driven by big ideas, enduring understandings, and what the community wants to sustain or change; (b) teachers balance student agency and learning goals; and (c) teachers facilitate student engagement in an iterative sensemaking process.

This instructional vision was intended to provide concrete guidance about essential aspects of enacting inquiry-based instruction in classrooms, seeking to avoid the problem of an all-purpose adoption of an inquiry approach (Furtak et al., 2012). It would provide concrete guidance in the areas of design for curriculum, teacher professional development, and supplemental programming. With respect to curriculum adoption, the instructional vision would be used as a measuring stick of sorts to check that the curriculum supports all three categories and related aspects of NSS instruction. In the area of professional development, the team organized initial sessions around the instructional vision, using it to guide decisions about whole group learning and content-area break-out meetings. They also used the instructional vision to orient ongoing learning for teachers over the course of the year. Teachers identified which pieces of the vision they might need the most support with and wanted to focus on over the coming year. Connecting to supplemental programming, the team shared the instructional vision with nonprofit partners and modeled instruction aligned with the vision for them so that they could imagine what it would look like in the classroom and start to imagine corresponding shifts in their programming.

In addition to actively centering the instructional vision in design work, the team also worked to support coherence making (Forman et al., 2017; Fullan & Quinn, 2016) by anticipating points of tension or challenges and addressing (mis)alignment head on. One such challenge they expected was aligning the instructional vision and teacher evaluation, given research and experience from other partnership efforts focused on instructional improvement (e.g., Penuel, 2019). Therefore, they mapped examples from the instructional vision to the teacher evaluation framework to show school leaders and teachers how the instructional vision was compatible with the district expectations. Thus, teachers and school leaders would be less likely to feel pulled in different directions as they were trying to innovate.

The NSS instructional vision is centered on STEM and project-, problem-, and place-based instruction, aiming to provide concrete guidance for school designers and school staff to support coherence making (Forman et al., 2017; Fullan & Quinn, 2016). Even though this instructional vision was developed by starting with science, math, and project-based learning frameworks, it was intended to support high-quality instruction across the whole school, including other content areas and electives. The project team ensured this cross-curricular inclusion by bringing in partners with expertise in different content areas to provide feedback along the way. We believe that this framework could support other schools needing a shared inquiry-based instructional vision to support instructional improvement. This framework can support the conceptualization of high-quality, culturally sustaining pedagogy across content areas, which can support cross-disciplinary research on instruction.

Implications

Creating the instructional vision document was valuable both as a process and a product. The process of creating the shared vision forced the partnership to have concrete conversations about goals for instruction and provided grounded opportunities for feedback and the development of a shared vision. The product gave the partnership team something to use to evaluate the quality and fit of curriculum options and a yardstick against which teachers could identify areas of growth they wanted to focus on in professional learning communities. Administrators and instructional leaders helped balance competing initiatives and explicitly defined the buzzwords thrown into the mix by the district, university, and corporate partner. Similar to the longstanding method of instructional planning known as Understanding by Design (Wiggins et al., 2005), the instructional vision focused the partnership team on the "enduring understandings" they identified all students need when heading off to high school while leaving space to serve the particular community history and context. Specifically, the NSS Instructional Vision provides a broadly applicable and carefully specified framework for inquiry-based teaching, with roots in culturally sustaining pedagogy, allows for adaptation to various contexts, and prioritizes ambitious learning goals for students.

Author Bios

Anne Garrison Wilhelm is an Associate Professor in the Department of Teaching and Learning at Southern Methodist University. Dr. Wilhelm studies teacher learning and practice, with an emphasis on in-service teacher learning.

Jamie Gravell is an Assistant Professor in the Department of Advanced Studies at California State University - Stanislaus. Dr. Gravell's research focuses on teacher learning, digital technologies, and civic education.

Robyn K. Pinilla is a doctoral candidate at Southern Methodist University studying early childhood mathematics and teacher professional learning. She formerly served as an early childhood teacher and elementary administrator in a large urban school district.

References

Augé, M. (1995). *Non-places: An introduction to supermodernity* (2nd ed.). Verso.

Barrows, H. S. (1996). Problem-based learning in medicine and beyond: A brief overview. *New Directions for Teaching & Learning, 1996*(68), 3–12. https://doi.org/10.1002/tl.37219966804

Bertling, J. G. (2018). Non-place and the future of place-based education. *Environmental Education Research*, *24*(11), 1627–1630. https://doi.org/10.1080/13504622.2018.1558439

Boerema, A. J. (2006). An analysis of private school mission statements. *Peabody Journal of Education*, *81*(1), 180–202. https://doi.org/10.1207/S15327930pje8101_8

Bryk, A., & Schneider, B. (2002). *Trust in schools: A core resource for improvement*. Russell Sage Foundation.

Bryson, J. M. (2012). Strategic planning and management. In B. G. Peters & J. Pierre (Eds.), *The SAGE handbook of public administration* (pp. 50–65). SAGE. https://doi.org/10.4135/9781446200506.n4

California Department of Education. (2022). *Culturally sustaining pedagogy.* https://www.cde.ca.gov/pd/ee/culturallysustainingped.asp

Coburn, C. E., Russell, J. L., Kaufman, J. H., & Stein, M. K. (2012). Supporting sustainability: Teachers' advice networks and ambitious instructional reform. *American Journal of Education, 119*(1), 137–182. https://doi.org/10.1086/667699

Cohen, D. K., & Ball, D. L. (1999). *Instruction, capacity, and improvement* (CPRE Research Report RR-43). Consortium for Policy Research in Education, University of Pennsylvania. https://www.cpre.org/sites/default/files/researchreport/783_rr43.pdf

Cohen, D. K., Spillane, J. P., & Peurach, D. J. (2017). The dilemmas of educational reform. *Educational Researcher, 47*(3), 204–212. https://doi.org/10.3102/0013189X17743488

Dean, C. P., Grossman, P., Kurshan, B., Remillard, J., Li, E., Ebby-Rosin, R., Farmer, S. O., Greenwald, B., Johnson, K. A., Morrison, M., & Szczesny, T. (2016, December). *The core practices of project-based teaching*. The Pennsylvania State University Graduate School of Education.

Dufour, R., Dufour, R., & Eaker, R. (2008). *Revisiting professional learning communities at work: New insights for improving schools.* Solution Tree Press.

DuFour, R., & Eaker, R. (1998). *Professional learning communities at work: Best practices for enhancing student achievement.* National Educational Service.

Elmore, R. F., Forman, M. L., Stosich, E. L., & Bocala, C. (2014, April). *The internal coherence assessment protocol & developmental framework: Building the organizational capacity for instructional improvement in schools.* Strategic Education Research Partnership.

Elmore, R. F., Peterson, P. L., & McCarthey, S. J. (1996). *Restructuring the classroom: Teaching, learning, and school organization.* Jossey-Bass.

Farrell, C. C., Penuel, W. R., Coburn, C., Daniel, J., & Steup, L. (2021). *Research–practice partnerships in education: The state of the field*. William T. Grant Foundation.

Forman, E. A., Ramirez-DelToro, V., Brown, L., & Passmore, C. (2017). Discursive strategies that foster an epistemic community for argument in a biology classroom. *Learning and Instruction*, *48*, 32–39. https://doi.org/10.1016/j.learninstruc.2016.08.005

Fullan, M., & Quinn, J. (2016). *Coherence: The right drivers in action for schools, districts, and systems.* Corwin.

Furtak, E. M., Seidel, T., Iverson, H., & Briggs, D. C. (2012). Experimental and quasi-experimental studies of inquiry-based science teaching: A meta-analysis. *Review of Educational Research*, *82*(3), 300–329. https://doi.org/10.3102/0034654312457206

Gay, G. (2018). *Culturally responsive teaching: theory, research, and practice* (3rd ed.). Teachers College Press.

Gravell, J., & Sedlacek, Q. C. (2021, April 16). *A shared vision: Applications of WDSS instructional vision and learner profile* [Presentation]. Caruth Institute for Engineering Education Friday Research Talk Spring Conference, Southern Methodist University, Dallas, TX, USA.

Gruenewald, D. A. (2003). Foundations of place: A multidisciplinary framework for place-conscious education. *American Educational Research Journal*, *40*(3), 619–654. https://doi.org/10.3102/00028312040003619

Gurley, D. K., Peters, G. B., Collins, L., & Fifolt, M. (2015). Mission, vision, values, and goals: An exploration of key organizational statements and daily practice in schools. *Journal of Educational Change*, *16*(2), 217–242. https://doi.org/10.1007/s10833-014-9229-x

Hammerness, K. (2001). Teachers' visions: The role of personal ideals in school reform. *Journal of Educational Change*, *2*(2), 143–163. https://doi.org/10.1023/A:1017961615264

Hanington, B., & Martin, B. (2017). *The pocket universal methods of design: 100 ways to research complex problems, develop innovative ideas and design effective solutions*. Rockport.

Honig, M. I., & Hatch, T. C. (2004). Crafting coherence: How schools strategically manage multiple, external demands. *Educational Researcher*, *33*(8), 16–30. https://doi.org/10.3102/0013189X033008016

Horn, I. S., & Little, J. W. (2010). Attending to problems of practice: Routines and resources for professional learning in teachers' workplace interactions. *American Educational Research Journal, 47*(1), 181–217. https://doi.org/10.3102/0002831209345158

Ladson-Billings, G. (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, *32*(3), 465–491. https://doi.org/10.3102/00028312032003465

Larmer, J. (2020, July, 22). *Gold standard PBL: Essential project design element*s [Blog post]. Buck Institute for Education. http://www.bie.org/blog/gold_standard_pbl_essential_project_design_elements

Munter, C. (2014). Developing visions of high-quality mathematics instruction. *Journal for Research in Mathematics Education, 45*(5), 585–636. https://doi.org/10.5951/jresematheduc.45.5.0584

Munter, C., & Correnti, R. (2017). Examining relations between mathematics teachers' instructional vision and knowledge and change in practice. *American Journal of Education, 123*(2), 171–202. https://doi.org/10.1086/689928

Munter, C., & Wilhelm, A. G. (2021). Mathematics teachers' knowledge, networks, practice, and change in instructional visions. *Journal of Teacher Education*, *72*(3), 342–354. https://doi.org/10.1177/0022487120949836

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*.

National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all.*

National Governors Association Center for Best Practices, Council of Chief State School Officers. (2010). *Common Core State Standards*.

National Research Council. (2001). *Adding it up: Helping children learn mathematics*. National Academies Press. https://doi.org/10.17226/9822

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas.* National Academies Press.

Newmann, F. M. (Ed.). (1996). *Authentic achievement: Restructuring schools for intellectual quality.* Jossey-Bass.

Paris, D. (2012). Culturally sustaining pedagogy: A needed change in stance, terminology, and practice. *Educational Researcher*, *41*(3), 93–97. https://doi.org/10.3102/0013189X12441244

Penuel, W. R. (2019). Infrastructuring as a practice of design-based research for supporting and studying equitable implementation and sustainability of innovations. *Journal of the Learning Sciences*, *28*(4–5), 659–677. https://doi.org/10.1080/10508406.2018.1552151

Ravitch, S. M., & Carl, N. M. (2015). *Qualitative research: Bridging the conceptual, theoretical, and methodological*. SAGE.

Robinson, V., Bendikson, L., McNaughton, S., Wilson, A., & Zhu, T. (2017). Joining the dots: The challenge of creating coherent school improvement. *Teachers College Record*, *119*(8), 1–44. https://doi.org/10.1177/016146811711900803

Rosenholtz, S. J. (1985). Effective schools: Interpreting the evidence. *American Journal of Education*, *93*(3), 352–388. https://doi.org/10.1086/443805

Roth, K. J., Bintz, J., Wickler, N. I. Z., Hvidsten, C., Taylor, J., Beardsley, P. M., Caine, A., & Wilson, C. D. (2017). Design principles for effective video-based professional development. *International Journal of STEM Education, 4*(1), Article 31. https://doi.org/10.1186/s40594-017-0091-2

Savery, J. R. (2015). Overview of problem-based learning: Definitions and distinctions. In A. Walker, H. Leary, C. Hmelo-Silver, & P. A. Ertmer (Eds.), *Essential readings in problem-based learning: Exploring and extending the legacy of Howard S. Barrows* (pp. 5–16). Purdue University Press. https://doi.org/10.2307/j.ctt6wq6fh.6

School Reform Initiative. (2021). *Constructivist Tuning Protocol.* https://www.schoolreforminitiative.org/download/constructivist-tuning-protocol/

Stein, M. K., & Coburn, C. E. (2008). Architectures for learning: A comparative analysis of two urban school districts. *American Journal of Education*, *114*(4), 583–626. https://doi.org/10.1086/589315

Theobald, P., & Curtiss, J. (2000, April). Communities as curricula. *Forum for Applied Research and Public Policy, 15*(1), 106–111.

Wiggins, G., Wiggins, G. P., & McTighe, J. (2005). *Understanding by design*. ASCD.

Windschitl, M., Thompson, J., & Braaten, M. L. (2018). *Ambitious science teaching*. Harvard Education Press.