

Providing High-Quality Professional Learning Opportunities Through a Lesson Study Conference

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Abstract

We report on the development and implementation of a conference designed to highlight the Next Generation Science Standards (NGSS Lead States, 2013) using lesson study as an effective professional-development practice for inservice teachers. The purpose of this article is to highlight details from the development and implementation that can be used by others wishing to replicate the conference. First, we give an overview of the practice of lesson study and explain how it was used by one of four lesson study teams that taught their research lesson publicly at the conference in front of 80 observers. Then, we describe a sample research proposal and share specific information about the processes used to coach the lesson study teams and plan the conference, and we share conference agendas and diagrams of lesson implementations to support readers' visualization of the implementation. Finally, we conclude with three planning components that were vital to our ability to execute the conference and link the design to existing lesson study literature.

Introduction

Science education has sought to improve student learning since its inception as a discipline. The publication of *A Framework for K-12 Science Education* (National Research Council, 2012) seeks to advance that agenda with equitable outcomes for all students; however, wide-spread implementation of instructional practices that breathe life into its vision and those of the *Next Generation Science Standards* (NGSS; NGSS Lead States, 2013) has yet to be realized. One means to improve student learning is to improve teachers' instruction, which necessitates teachers' learning. Yet, opportunities for teachers to learn in science remain infrequent, especially in the elementary grades (Plumley, 2019).

A recent meta-analysis identified five evidence-based conditions for teachers to improve instructional quality: Learning opportunities must (1) be sustained, (2) focus on daily problems of teaching, (3) support teachers' focus on student thinking, (4) develop teacher communities, and (5) study and enact particular instructional routines and practices (Gibbons & Cobb, 2017). Lesson study was identified as one of six potentially productive coaching activities that met all five of the conditions (Gibbons & Cobb, 2017). As a practice, lesson study foregrounds collaborative teacher research into the intersections between standards, research findings, and instructional materials, resulting in a lesson designed to test an instructional hypothesis. Therefore, lesson study provides a structure for teachers to dig into

the fundamental goals of the National Research Council's (2012) framework and the NGSS and test if and how their best instructional ideas yield student learning outcomes in the classroom.

To provide teachers with training in the NGSS and to spark a catalyst for the growth of lesson study beyond a single classroom or school, we developed and implemented three lesson-study conferences. The goal of this article is to report on the first-year conference design and the lesson study process used to facilitate it. We chose to focus on the first year of the conference to highlight the details of the foundational design to assist others in replication, should they choose to do so. To prepare this article, we conducted a retrospective analysis of artifacts from the first year.

In addition to organizing the conference, most of the authors doubled as lesson study coaches for the teaching teams. This positionality allows us to report on aspects of the lesson study process and the conference design. We analyzed information from records, including notes from team meetings, conference organizer meetings, artifacts, news coverage, and photographs. The utilization of cloud-based documents and the tracking of changes to documents (in this case, Google Docs) facilitated this process.

Lesson Study

The origins of lesson study have been traced to interactions between Japanese and U.S. teacher educators in the 1870s (Makinae, 2019). Lesson study took root in Japan and continues to provide a structure for teachers to collaboratively study and improve their standards, curriculum, instructional materials, and pedagogy (Dotger, 2015; Fernandez & Yoshida, 2012; Lewis et al., 2012; Takahashi & McDougal, 2016). Through a research cycle, a team of teachers and other educators, such as instructional coaches or administrators, work together through a four-phase process: study, plan, teach, and reflect. During the study phase, the teaching team selects a topic of interest and articulates a research theme, which states the instructional moves and tools that teachers will use in the research lesson and the hypothesized student learning that will be evident as a result. The team investigates their own and their students' knowledge of the concept. The team then shifts to the plan phase, designing a lesson that will elicit the students' thinking that the participants will review to evaluate their research hypothesis.

An example of a research hypothesis might be as follows: By using board work, student writing, and discourse practices, more students will contribute to building a consensus model. The research hypothesis drives the team's study of the curriculum materials and their plan for instruction. The studying and planning should be integrated with one another. Teams are often facilitated through the process by a knowledgeable other or "coach" with experience in the content area and lesson study. Collectively, the team and coach plan a

research lesson embedded within the larger unit of study that will be taught by one member of the team while the other members and the coach collect evidence of student thinking in real time. This evidence is used following the lesson to evaluate the research hypothesis. When additional observers who are not members of the teaching team help gather data, the research lesson is “public.” To these observers, the research lesson may seem like a singular event in the lesson study process. However, the research lesson cannot be divorced from its context within the larger unit of study, especially because the team’s work during the study and plan phases expanded not only their knowledge of the instructional actions contained in the research lesson but also their knowledge of the whole unit. For the sake of organization and brevity, we point interested readers to in-depth descriptions of the lesson study process as described in other works (e.g., Seleznyov, 2018; Takahashi & McDougal, 2016, 2019).

A Science Lesson Study Conference

In 2016, the state’s adoption of an adapted set of standards based on the NGSS drove teachers’ need for professional development opportunities. Our team included a science teacher educator, a coordinator of science professional development for the region’s state-endorsed educational agency, an assistant superintendent of instructional support, and a classroom teacher experienced with lesson study. The varied professional roles of our team members positioned us to notice and respond to that need for professional development. We envisioned using lesson study as a means to improve teachers’ instructional practice and familiarity with the NGSS. Further, we brought multiple teaching teams together in a lesson study conference to share that learning with others. To meet these goals, we took on multiple roles, including planning the conference and coaching the teams. Given the cyclical nature of lesson study and the overlapping responsibilities of roles, reporting on these practices simultaneously is difficult. To provide insight into both, we first discuss the experience of one teaching team and their research lesson, and then we discuss the preparation for and implementation of the conference.

The Experience of a Teaching Team

Several criteria were considered for selection, including the team’s previous experience with teaching a live research lesson, the team’s familiarity with the instructional units, and the proposed grade level focus for the lesson study cycle. These criteria allowed us to narrow our focus in three ways. First, this limited the span of grade levels that would be represented at the conference, which allowed for an in-depth focus on the changes required by the new standards for elementary science. Second, because these teams had at least some members who had previously participated in lesson study, we focused more on the

standards and instructional materials than on the lesson study process. Likewise, given the size and scope of the conference, we believed that teams with experience would feel more confident about their participation than those without experience. Table 1 provides information on the grade level focus for the research lessons, the coaches, the size of the teaching teams, and the number of people on each team with prior lesson study experience.

Table 1
Lesson Study Team Information

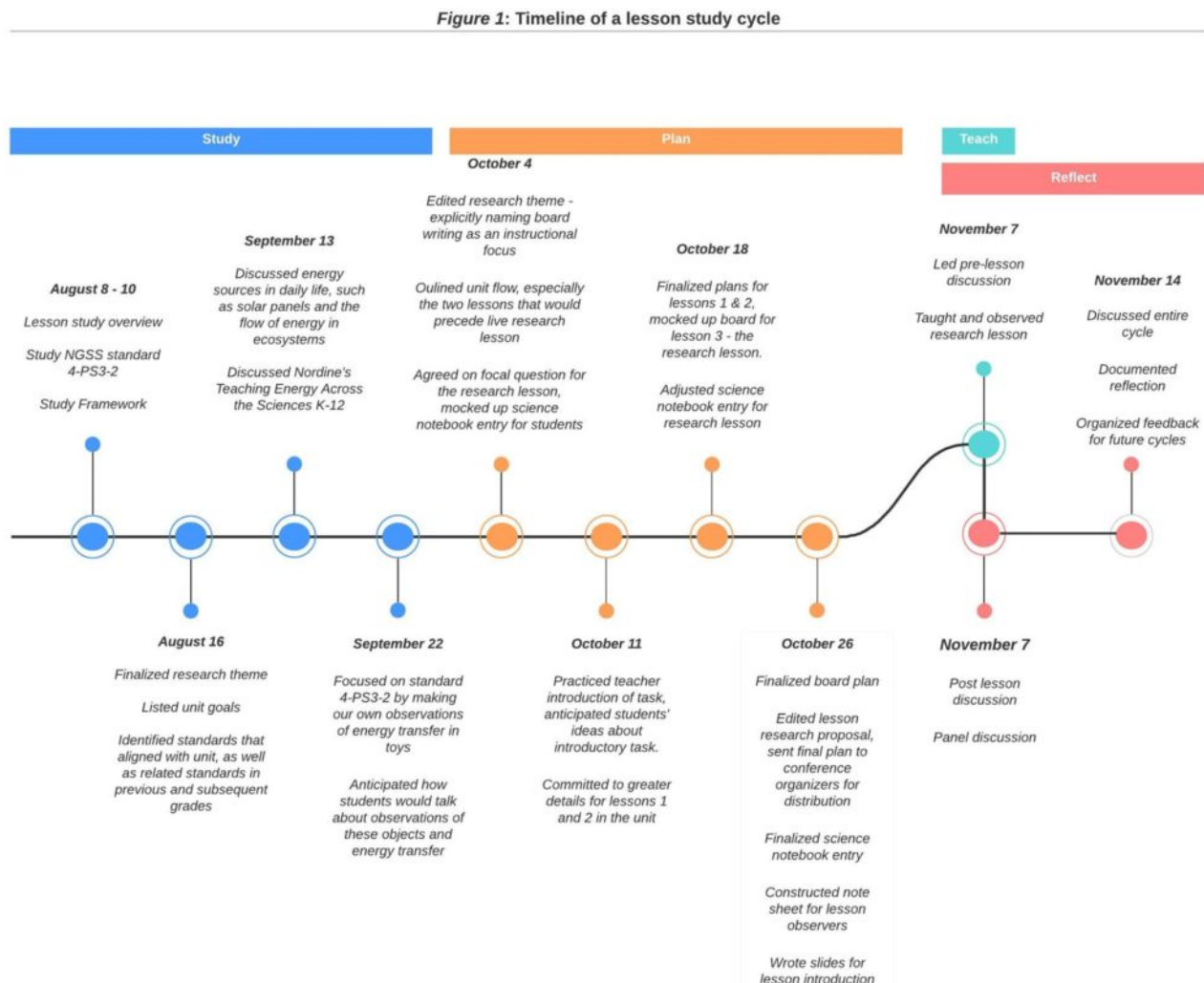
Year 1				
District	A	B	C	D
Grade	4th	2nd	5th	6th
Topic	Energy Transfer	Erosion	Water Systems	Lunar Phases
Coach	Author 1	Author 2	Author 2	Author 1 & Author 4
Members with LS Experience/ Team Size	2/4	3/5	4/6	3/6

Once recruited, teams participated in a full lesson study cycle. To illustrate, we focus here on the experience of the fourth-grade teaching team. This team consisted of four elementary teachers, two of whom had prior lesson study experience, and was coached by the first author. She oversaw the lesson study cycle and assisted the teaching team in finding instructional resources, developing their research theme, and studying the content. Like all other teams, they attended the summer jumpstart institute held in August, which was designed and facilitated by the first two authors. During this time, the teaching teams refined their lesson study ideas and studied the NGSS, related documents, and instructional materials. By the end of the summer meeting, each teaching team began planning their unit and the lesson they felt would best allow them to investigate their research hypothesis.

At the conclusion of the summer jumpstart, the teaching team and coach scheduled ongoing meetings (approximately every 7–10 days) to continue their study of materials and the preparation for the public research lesson. Once the school year started, these meetings were held after school, and members of the teaching team received minimal compensation for their time.

Figure 1 provides details of the work undertaken by the fourth-grade team and their coach as they progressed through lesson study's study, plan, teach, and reflect stages. The figure shows that a great deal of lesson study work occurred prior to the research lesson and that the public research lesson was only a small portion of the whole cycle. In the context of the conference, however, the research lesson was the most public component.

Figure 1
Timeline of a Lesson Study Cycle



Because this team taught their research lesson publicly, they created a presentation for the attendees who observed the lesson. They emailed their lesson research proposal to the conference attendees a few days prior to the conference. The purpose of the presentation was to update observers on any changes, introduce them to lesson study, introduce observation procedures and norms, and answer questions. Following the presentation, one member of the teaching team taught the research lesson. After the research lesson, the team held the post-lesson discussion.

A Sample Research Lesson

For the sample research lesson, we continue to use the fourth-grade team from the first year as an example case. Unlike the other teams in the first year, this team did not have a new set of instructional materials to work from; therefore, they adjusted their old materials. Their research theme focused on whether the use of science notebooks and careful planning of whiteboard space by the teachers could enhance the students' learning. They hypothesized that by using notebook writing, students would be able to better explain their reasoning to others and generate claims that connected observations together to answer the research question. When the teachers set their research theme, they noted that in prior years, their students seemed to struggle with explaining themselves to their peers or comparing their ideas to those of their classmates. Further, they hypothesized that careful use of the board to document student thinking would create an exemplar for students to draw from in constructing their own notebook entries and make their thinking visible to one another. Because the research lesson was a continuation from a lesson that they began in their home classroom, the board helped students link ideas across lessons.

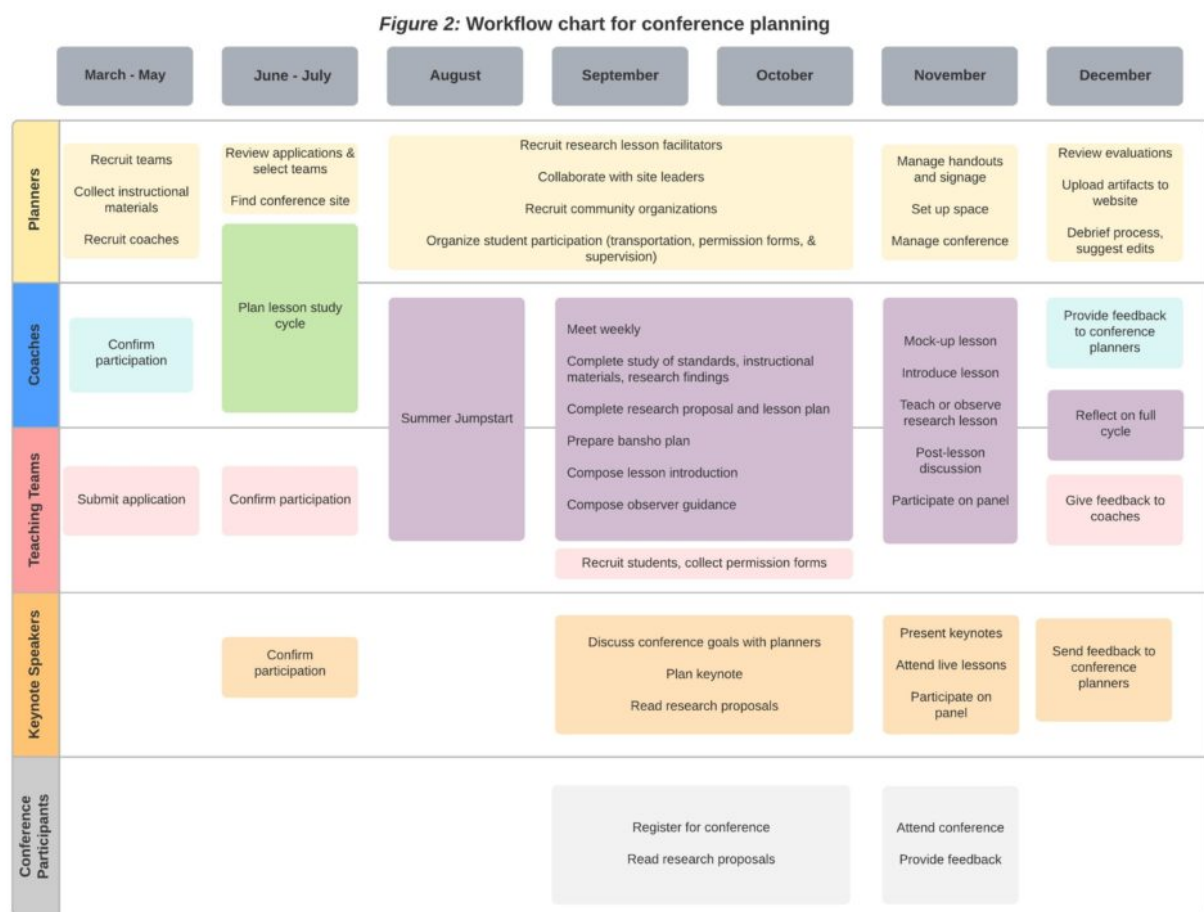
The research lesson took 2 days to complete—only the second day was public at the conference. The lesson goal was for students to be able to answer the focus question: How do objects change during an interaction? In the first half of the lesson, they observed a hand boiler as a class and then discussed what they noticed before, during, and after the interaction between a hand and a hand boiler. Students then worked in four teams at three stations to record their observations in their science notebooks. In the second half of the lesson, the students observed three more stations, recorded their observations, and then discussed as a class how they could answer the focus question and support their answer with evidence from multiple interactions among the seven that they studied.

In their research proposal, the team articulated multiple questions to guide lesson observers in gathering helpful evidence of student reasoning. One of the key questions that the team had when planning was the degree to which they should structure students' exploration of manipulatives and records in the science notebook. To gather information from the research lesson to address this question, the teaching team posed several questions to the observers to guide their observations of students. These questions included: How are the students observing the objects and their interactions? How are the students recording their observations? What language are the students using to describe their thinking? The teaching team wanted to use this evidence to evaluate the efficacy of the structure they provided students in bringing together multiple observations to build an explanation.

The Conference Experience

Preparation for the conference began 10 months prior to the date it was held with the recruitment of the teaching teams. Figure 2 provides a detailed account of the tasks undertaken to prepare for and conduct the conference and outlines which tasks fell to which groups. The colors in the chart are used to clarify the tasks for each group and show the interactions between groups over time. For example, the work of the conference planners, shown in yellow, intersected with the coaches' work, shown in blue, over the summer. This overlapping effort is shown in green to demonstrate this cooperation. Because the coaches worked so closely with the teaching teams, much of their combined work is shown in purple.

Figure 2
Workflow Chart for Lesson Study Conference Planning



We held the conference on a regional professional development day when classes were not in session. This enabled the conference to be held at a local school, which reduced costs and provided the multiple, large, open meeting spaces needed. Additionally, teachers did not require substitute teacher coverage, administrators were able to attend, and students could participate in the live research lessons without missing class time. Teaching team members recruited students at the grade level of their live research lesson to participate. The team sent a letter to parents informing them of the conference agenda, planned activities for the

students, and the transportation plan. This letter also requested their permission for their child to attend and be photographed or interviewed by local media and inquired about medical needs. Each team was able to recruit the majority of students in the focal class to participate in the conference so that the lesson mimicked a typical class day. Teaching assistants from the students' districts accompanied them for the day, and students were bussed to the conference location from their home school. When students were not in the live research lesson, they attended enrichment experiences at the conference location with local children's programs from museums, the zoo, and a local gym. Elements like color-coded classroom t-shirts and bagged lunches helped to make the day special for students, and the students also received a big round of applause from the conference attendees.

Conference participants were recruited from over 20 public K–12 school districts in the region. Although the research lessons were limited to Grades 2–6 content, participants from across the K–12 spectrum were encouraged to attend due to the novelty of the standards and the lack of experience most teachers had with them. For many conference participants, this was the first opportunity they had to see lessons designed for the NGSS. Additionally, school and district administrators, including instructional coaches, curriculum coordinators, principals, and superintendents, attended the conference, as did some preservice teachers and faculty from a local university. In the first year, 338 participants attended the conference.

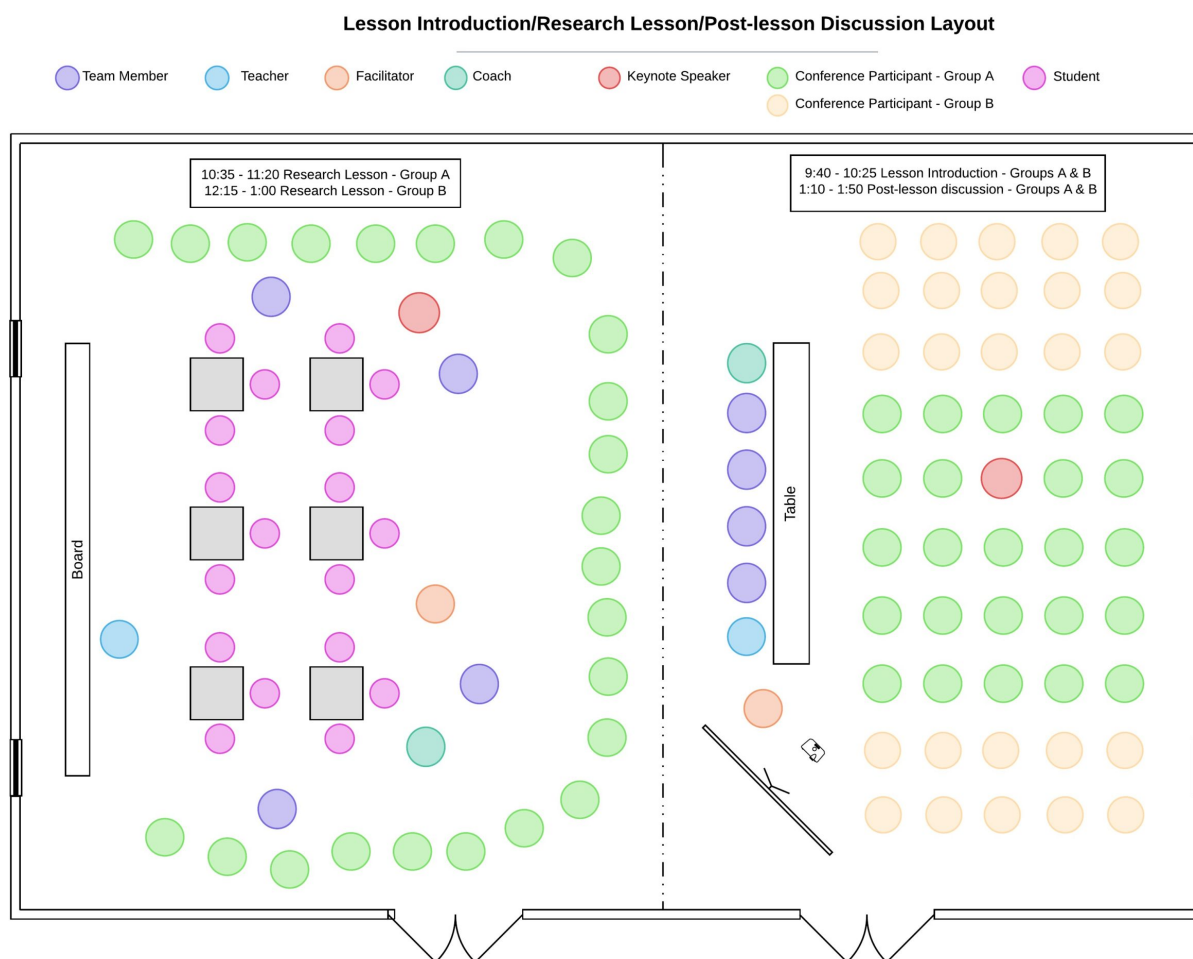
The full agenda for the conference is shown in Figure 3. To begin the day, the conference organizers introduced the audience to the agenda and explained their vision for the conference design. Immediately following, all attendees listened to a keynote address given by a director of a national center focused on science education. She explained the purpose of her center and how it responded to the NGSS and gave an overview of evidence on the efficacy of the center's teacher professional development and instructional materials design projects.

Figure 3
Conference Agenda

	All participants		Green Team		Blue Team		Red Team		Yellow Team	
Time	Activity	Location	Activity	Location	Activity	Location	Activity	Location	Activity	Location
8:00 - 8:20	Registration and Coffee	Lobby and Cafeteria								
8:25 - 8:40	Introduction	Auditorium								
8:40 - 9:30	Keynote	Auditorium								
9:40 - 10:25			Research Lesson Introduction - 5th	Large Gym A	Research Lesson Introduction - 2nd	Large Gym B	Research Lesson Introduction - 4th	Auditorium	Research Lesson Introduction - 6th	Library
10:35 - 11:20			Research Lesson - 5th or Keynote 2	Large Gym A or Auditorium	Research Lesson - 2nd or Keynote 2	Large Gym B or Auditorium	Research Lesson - 4th or Keynote 2	Music Room or Auditorium	Research Lesson - 6th or Keynote 2	Library or Auditorium
11:30 - 12:10	Lunch	Cafeteria								
12:15 - 1:00			Research Lesson - 5th or Keynote 3	Large Gym A or Auditorium	Research Lesson - 2nd or Keynote 3	Large Gym B or Auditorium	Research Lesson - 4th or Keynote 3	Music Room or Auditorium	Research Lesson - 6th or Keynote 3	Library or Auditorium
1:10 - 1:50			Post Lesson Discussion - 5th	Large Gym A	Post Lesson Discussion - 2nd	Large Gym B	Post Lesson Discussion - 4th	Auditorium	Post Lesson Discussion - 6th	Library
2:05 - 2:45	Panel Discussion	Auditorium								
2:45 - 3:00	Next Steps	Auditorium								

Following the keynote address, the conference shifted to the research lessons. Each conference participant was assigned to one of four research lesson introductions based on grade-level preferences gathered during registration. The introduction oriented the observers to the teaching team's goals and provided an overview of the lessons the students experienced leading up to the research lesson. The teaching teams also shared their research hypotheses and the rationale for their lesson design and gave guidance to the observers on gathering specific evidence of student thinking that would be used in the post-lesson discussion to evaluate the research theme. Figure 4 shows the layout of one of the gymnasium spaces for the research lesson introduction, research lesson, and post-lesson discussion. The intent of the figure is to show the multiple uses of the space as well as assist the reader in visualizing the interactions between the teaching teams, facilitators, coaches, keynote speakers, conference participants, and students. Facilitators were assigned to each research lesson to act as moderators, upholding discussion norms and guidelines for observations. Facilitators were colleagues with prior knowledge of lesson study and prior experience with teacher professional development.

Figure 4
Lesson Introduction, Research Lesson, and Post-lesson Discussion Layout



Each of the four teaching teams taught their lesson twice with different student groups. The teachers had recruited enough students from the appropriate grade level at their school to split between the two lessons. At the conclusion of the lesson and the second keynote, the two groups switched; the group that came from the keynote went to the second iteration of the research lesson, and the group that came from the research lesson went to the third keynote presentation (Keynote 3).

The keynote speeches that ran opposite of the research lessons were given by a science teacher educator with two decades of experience in elementary science education and a classroom teacher from another state who had already been teaching using the NGSS. The teacher educator spoke to the kind of teacher learning that was required for teachers to implement the NGSS, whereas the classroom teacher shared her experiences and advice for transitioning to NGSS-aligned instruction and attending to associated assessment demands. Each was selected to further the conference's goal to connect local classroom-level work with national initiatives in improving science teaching and learning. The design decision to have two different keynotes was based on two key considerations. First, we wanted to limit the number of observers present in any research lesson. By offering the lesson twice, each

lesson was observed by approximately 40 educators rather than 80. Second, we wanted the keynote speakers to be able to observe a research lesson to facilitate their opportunity to connect their expertise to the learning experience for the students. Therefore, the second keynote speaker observed the first lesson iteration, and the third keynote speaker observed the second lesson iteration.

Following the second iteration of the research lesson, Groups A and B reconvened in the same space where the lesson introduction took place. The facilitator led the post-lesson discussion using established protocols (Lewis et al., 2019; Takahashi & McDougal, 2016). The teacher of the research lesson shared their thinking about the lesson first, followed by their teammates, and then the facilitator invited observations of student thinking from conference participants and final comments from the attending keynote speaker. Through this collaborative approach, the group collectively evaluated the teaching team's research theme and discussed its implications for future instruction.

To conclude the conference, everyone gathered for a panel discussion in the auditorium. The goal of the panel discussion was to connect the topics raised in the keynotes, the research lessons, and our collective observations of student thinking. The panel members included the first two authors, two conference organizers, the keynote speakers, and a member of each of the four teaching teams. The third author facilitated the panel discussion, allowing time for panelists to comment on the goals of the conference and taking questions and comments from the audience. During the closing and next steps, participants were asked to complete a Google evaluation form. The evaluation included six Likert-scale questions with the option to add comments to each response. Of the conference participants, 273 completed the evaluation form.

Overall, conference participants provided generally positive feedback about their experience. The results are summarized in Table 2. As we compare the responses across the questions, we notice that participants were most positive about attending additional professional development at the regional science center that focused on the new standards. Participants were more interested in conducting lesson study with colleagues as opposed to studying standards with colleagues. One way to interpret this difference is that the participants need additional opportunities to learn about lesson study to understand that studying standards with colleagues is a core component of the study phase.

Table 2
Likert-Scale Evaluation Responses (n = 273)

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I learned how students think about science as represented in the new standards.	38.4%	33.9%	18.5%	6.6%	2.6%
I am interested in conducting lesson study with colleagues.	45.7%	21.7%	19.9%	6.7%	6.0%
I plan to develop a study group about the standards with my colleagues.	32.9%	19.2%	26.7%	9.0%	12.2%
I am interested in attending professional development about the new science standards with your center.	67.6%	18%	7.7%	3.3%	3.3%
If there were another conference like this in the future, I would attend.	62.1%	17.3%	12.5%	3.3%	4.8%
If there were another conference like this in the future, I would encourage colleagues and administrators to attend.	68.5%	16.5%	11.0%	1.1%	2.9%

Survey respondents added 40 comments about conducting lesson study with colleagues that ranged from “All teachers should do this” to “Not at this time” or “Time to work with others is limited.” When asked if they would attend another conference like this in the future, 38 respondents added comments. More than a third asked for there to be lessons that focused on middle and high school contexts—which we did in subsequent years. Other isolated comments included, “It was amazing to be able to watch and discuss authentic student learning,” and “I was on one of the teaching teams and would definitely participate again.” Fortunately, members of teaching teams did return for additional work in subsequent years and brought additional colleagues with them. Although this may not be a direct measure of their learning, teachers’ continued participation is a signal of their interest and that they found the process valuable.

Discussion and Conclusion

The purpose of this article was to report on the first-year conference design and the lesson study process used to facilitate it. To that end, here we expand on three components that we consider crucial to the success of the conference. First, we decided to hold the conference on a professional development day, which meant that classes were not in session. This decision had implications for the entire conference design, including the number and type of participants we were able to recruit. Additionally, we used a school as the conference

location, which gave us access to multiple large instructional spaces (e.g., auditorium, gymnasiums, music rooms, and library). If we held the conference during a typical school day, we would have had to limit the number of public lessons and the number of participants who could attend the conference. However, because the conference took place on a professional development day, we needed to recruit students to participate in a learning opportunity on a “day off” at a different location. Therefore, as Figure 2 clarifies, we created a student schedule that mimicked a traditional school day, including providing transportation, supervision, and enrichment activities for the students when they were not in the research lessons.

Second, the progression of the lesson study cycle for the teaching teams was influenced by several factors. Once the conference date was identified, the coaches collaborated with the lesson study teams during the summer jumpstart to set a progression of meetings during September and October that allowed them to complete the study and plan phases of their cycle. Each of the research lessons was embedded within larger instructional units. Because the research lessons were not isolated events, teaching teams had to carefully implement their lessons so that students would be in the right place and last-minute edits to the lesson research proposals would be minimized. Each of these factors influenced the pace at which the research proposals were constructed and shared with conference participants. Additionally, teachers wanted to build on the learning of their students from the research lesson, which implicated the remaining lessons in the unit that they taught.

Finally, the collaborative nature of lesson study and conference design and implementation cannot be overstated. Although Figure 2 demonstrates the collaboration required between various stakeholders involved in the conference, it does not illustrate the additional collaboration and communication required to host the conference. This collaboration included meetings with the host-site school principal and custodial staff to arrange for the setup of the instructional spaces, communication with audio-visual specialists to assist with technology and sound needs, and getting access to the school the night before the conference to allow for setup and for the teaching teams to orient themselves to new instructional spaces. Multiple teaching teams elected to practice their research lesson in their revised instructional space the evening before to visualize how the delivery of the lesson would feel for them and how they wanted to orient tables, chairs, rugs, and whiteboards for their students.

There is little doubt that inservice teachers require high-quality professional development experiences in order to implement the rigorous instructional shifts required of the NGSS. Our state’s shift in science standards and the subsequent changes in instructional materials presented opportunities for educators across the region to engage in professional development. We contributed to those opportunities by designing and facilitating a conference featuring public research lessons that were taught as the result of teaching teams’ engagement in systematic study of standards, content, and pedagogy through lesson study. The conference provided an avenue to simultaneously center both the voices of experts—those who have contributed to the authorship of the NGSS, designed instructional

materials to bring them to life, or field tested newly developed assessments of students learning—and the expertise of local, practicing teachers who engaged in a lesson study cycle about those standards, using those instructional materials, and enacting instructional practices meant to make students' thinking visible and audible to lesson observers. By making their practice public, the teaching teams offered conference participants an opportunity to see how elementary science instruction could develop and also allowed them to discuss lesson efficacy considering evidence of learning gathered as a lesson unfolded rather than only via an end-of-year summative assessment with underspecified connectivity to instruction.

In one of the first papers written in English that reintroduced lesson study to Western audiences, Lewis and Tsuchida (1998) suggested that “research lessons provide an opportunity for teachers to discuss big ideas currently shaping national educational debate, think them through, and bring them to life in the actual classroom” (p. 16). We sought to design a conference that would actualize this description of Japanese practice in a U.S. context, particularly at a time when stepping up to the potential of the NGSS would require the alteration of standard classroom practice and revitalization of elementary science instruction. We hope that by describing a conference designed to use public research lessons as a mechanism for studying the NGSS, we might encourage other teacher educators to use lesson study and their research lessons to publicly advance the goals of equitable science education for all learners.

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