



Research + Practice Partnerships: The Washington Partnership for Science and Engineering Practices

This case study focuses on the Partnership for Science and Engineering Practices (PSEP) in Washington state. PSEP began in summer 2013 with a 2-year grant. This study covers that two-year period (summer 2013 through summer 2015), includes a round of retrospective interviews conducted in winter 2016, as well as a brief epilogue describing the status in early 2017. The partnership has been sustained by an ongoing series of grants. Thus this report is meant to illuminate the formative stages of what has become an evolving arrangement.

This case focuses on the design and functioning of the partnership, with attention to several focal points of special interest to the “adaptation site/local lab” concept as outlined in the Sections below.

Section I. **An overview of the CTAN project** and a summary of CTAN’s activities.

Section II. **The conception, initiation, enactment, and evolution of the RPP**, focusing on the roles that researchers and practitioners played in decision-making and defining the work.

Section III. **The inquiry of common interest—its designation and evolution**, describing how the problem or inquiry was framed, has evolved, and been deemed important.

Section IV. **The relationships and interactions between researchers and practitioners**, portraying the roles and dynamics between the individuals involved, including the leadership team and classroom teachers.

Section V. **The multiple ways that participation in the partnership has benefited practitioners and researchers**. This study does not address long-term and more distal benefits to users of STEM tools distributed by the partnership.

Section VI. **The case as illuminative of design-based Research + Practice Partnerships**, reflecting on PSEP’s work in the larger context of the Collaboratory effort and on key elements of the partnership that have made it a functional and productive research and practice partnership. A white paper that examines ways in which such partnerships leverage research for educational improvement (Coburn, et al., 2013) frames this discussion.

The Research + Practice Collaboratory

The Research + Practice Collaboratory (<http://researchandpractice.org>) aims to explore and demonstrate ways that research and practice, and researchers and practitioners, can interact in a variety of non-traditional ways to support educational improvement. The original vision communicated to NSF: “The challenge is not how to create better or more devices or artifacts that translate research to practice but rather how to create richer opportunities for cultural exchanges between communities of research and practice (Coburn & Stein, 2010).” The Collaboratory created the concept of “adaptation sites,” later called “local labs,” to identify local STEM improvement projects where researchers and practitioners in a range of educational settings would partner for the purpose of creating such contexts for cultural exchanges leading to new knowledge and improved practices.

Inverness Research conducted multi-year case studies of the research-practice partnerships deemed “local labs” for the Collaboratory. The cases aim to portray details of the leadership, design, and implementation of the partnerships, and to offer reflections on key features that shaped the interactions and work of the joined communities of research and practice.

I. OVERVIEW

The “local lab” in Washington State was launched as a collaboration between two projects: the Partnership for Science and Engineering Practices (PSEP), which is a state-funded Math-Science Partnership, and the Research + Practice Partnership (RPP) at the University of Washington (UW), led by Philip Bell and Andy Shouse. District partners in the PSEP are Seattle Public Schools (SPS) and the Renton School District (RSD).

The Partnership for Science and Engineering Practices (PSEP)

The state-funded PSEP focuses¹ on the general problem area of Next Generation Science Standards (NGSS) implementation. Specifically, the grant supports groups of teachers in grades 3-8 in Seattle Public Schools and the Renton School District, working together to adapt their existing science curriculum to the NGSS. External partners in the PSEP grant include the UW Colleges of Engineering and Education and the Institute for Systems Biology (ISB). The curriculum adaptation focuses on three science and engineering practices included in the NGSS: engaging in arguments from evidence, constructing explanations, and engineering practices. The intention is that teachers will learn these practices and then adapt their materials and instructional plan to address them.

The key players in the Seattle and Renton districts are “practitioners” responsible for effective NGSS implementation in classrooms. Dan Gallagher, SPS Science Manager, directs the Seattle work and is PI of PSEP. Gallagher played a strong leading role in shaping the purpose of the PSEP grant and forming the partnership, and he remains hands-on as a leader of the work, supported by district teachers on special assignment (TOSAs) for science. The district leader in Renton School District is Monica Chandler, Director of Curriculum and Instruction. She is a key decision-maker for the project, with Kelly Jones, new Science and Health Program Manager for Renton, playing a more hands-on coordination role. Kelly was a teacher in the PSEP program in Year 1. In Year 2, after a key professional development leader who was an independent consultant departed the project, a new PSEP project manager was brought on—Gilda Wheeler, formerly at the Office of Superintendent of Public Instruction (OSPI), who reports to Gallagher.

In Seattle Public Schools, the project involves cohorts of about 40 teachers in grades 3-5, with teachers participating voluntarily through an application process. In the Renton District, the project involves middle school teachers, with the district expecting the participation of all teachers in those grades. The grant offers a yearlong professional development cycle consisting of six days of professional development in the summer, followed by three in-service days and a wrap-up day during the school year. The hope is that the teachers who participate in this grant will contribute to leading the implementation of NGSS in their districts and the state.

The original PSEP grant was for a two-year period, beginning in summer 2013 and ending in August 2015.² By the spring of 2015, there were roughly 40 teachers with two years of experience and

¹ Much of this case is written in the present tense, signifying that written documentation of the partnership took place steadily and cumulatively throughout the two years.

² PSEP II, a second state MSP, began when PSEP ended, extending the partnership and the work.

roughly 40 with one year of experience in the Seattle district. During Year 2, rather than being divided into two distinct cohorts by amount of experience with the project, teachers were grouped for their work according to the grade levels they teach, which means most grade-level groups have mixed experience. In Renton, all middle school teachers were involved both years, except newcomers to the middle schools, who participated only in Year 2.

The PSEP theory of action anchors to the idea that curriculum adaptation carried out by informed teachers will support teacher changes in classroom practice that are consistent with the NGSS. The theory assumes that teachers can learn key STEM practices emphasized in NGSS from science experts and can then make adaptations to the grade-level science units they are familiar with, adding the new NGSS practices to their units. These teachers can then begin sharing their new practices with colleagues in their schools. The professional development meetings aim to support teachers in the processes of curriculum adaptation and changes in teaching.

Dan Gallagher decided to adopt a curriculum adaptation approach to NGSS implementation partially in response to changing conditions in the Seattle district, where funding cuts nearly eliminated the cadre of Science TOSAs who had acted as lead teachers for professional development. In the PSEP model, every teacher participating in the professional development becomes a curriculum adapter, rather than being trained in adaptations made by a small group of TOSAs. Gallagher also espouses a strong belief in teachers as agents of change for both curriculum adaptation and the spread of NGSS-related science teaching in their schools.

One of the project leaders described the problem of classroom practice addressed by the curriculum adaptation work as follows:

I understand my goal is to get kids to do this [experience key STEM practices in NGSS], but what does that actually look and sound like? What are the words I should be saying, and what other kinds of questions should I be asking? What should my stance be in establishing the relationship with my students and in expecting my students to establish relationships with each other that actually make this work?

Important products generated from the PSEP will be the newly revised curriculum units themselves. Others will be examples of what these new teaching units and practices look like in action, for example, through videotapes of exemplary classrooms. Project leaders also see the increased capacity of teachers and PD providers to do this improvement work as an arguably more important outcome than the new materials.

The Research + Practice Partnership

The RPP's work is "bolted onto PSEP," in the words of one PI. The researchers aim to collaborate with PSEP in such a way as to 1) add direct value to the PSEP work, 2) develop research-practice relationships that will enable identification of persistent problems of practice involved in teachers' changing practices to meet the new NGSS, and 3) generate usable knowledge to address those problems within the participating districts and also more broadly in the field. The RPP serves PSEP directly by co-planning and co-facilitating professional development during the summer and school

year, offering in-depth classroom support to a small subset of teachers during the year, and producing tools to support implementation.

UW faculty members Philip Bell and Andy Shouse lead the RPP.³ Bell is Executive Director of the Institute for Science and Math Education (ISME) and is Director of the Learning Sciences Graduate program, the Everyday Science & Technology Research Group and co-director of the LIFE research center. Shouse is a research assistant professor in the College of Education and affiliated researcher at the Institute for Science and Math Education. In addition to serving on the leadership team for the PSEP partnership, Bell and Shouse help design and lead professional development for the project. UW graduate students—primarily Tana Peterman and Kerri Wingert, with additional support from Heena Lakhani and Veronica McGowan⁴—provide direct classroom room support for a small subset of participating teachers as well as help design and lead professional development activities for the partnership. The PSEP professional development workshops and the work with classroom teachers serve as settings for the graduate students’ dissertation research as well as for the RPP work of the partnership. The UW group refers to the in-class work with the small group of teachers as “deep dives” into the inter-related phenomena of curriculum adaptation, change in classroom practice, and impact on student learning.

The RPP is producing a collection of Stem Teaching Tools (<http://stemteachingtools.org>), in the form of “practice briefs,” that support NGSS implementation. Leaders of the RPP invented “practice briefs” as a form of research- and practice-based knowledge that is usable and transportable. In their look, language, and length, the practice briefs are intended to be accessible and appealing to a wide audience, including busy classroom teachers. In their content and links to multiple curated sources, they are intended to be entry points to relevant additional knowledge around the specific problems of practice they address.

The Partnership Designated a Collaboratory “Adaptation Site” or “Local Lab”

At the early stage of PSEP formation (2013), the school districts (with Seattle taking the lead) were the primary drivers of PSEP, with the UW researchers entering later into exploratory conversations about their role. In 2014-15, with two years under their belts, the PSEP PIs and the RPP PIs are truly collaborating as leaders of the PSEP. Leaders of both projects work as one team, invested in building capacity and sustainability for change in the districts and in producing usable knowledge for both research and practice. A practitioner PI described the evolution of the partnership this way:

At the very beginning of this partnership, Phil and Andy kind of signed on minimally as an advisor or something like that. Obviously they have evolved, they are a core big-time partner.

The RPP team plays multiple roles in the PSEP, both contributing expertise to it and drawing valuable knowledge from it, including:

- advising on leadership for the PSEP
- contributing to PSEP decision making and organization

³ Shouse left the RPP for Washington STEM in summer 2015 at the end of the two-year grant.

⁴ Additional graduate students have come on board later with the subsequent grant.

- helping to design and plan the professional development offered as part of the PSEP
- delivering a substantial proportion of the PSEP professional development, especially in Year 2
- directly helping a small subset of PSEP participants enact curriculum adaptations in their classrooms (“deep dives”)
- gathering teacher feedback and using classroom observations to inform the PSEP
- serving as hubs in the partnership’s professional network, facilitating the movement and adaptation of ideas and strategies amongst groups of teachers
- developing a research agenda related to how curriculum adaptation functions as a strategy for NGSS implementation
- drawing from the work with teachers to develop (and sometime co-develop) research-practice based tools, e.g., “practice briefs,” that support change in teaching.

Thus for Collaboratory purposes, the Local Lab comprises the PSEP/RPP as one collective effort.

II. THE CONCEPTION, INITIATION, ENACTMENT, AND EVOLUTION OF THE PARTNERSHIP

Dan Gallagher of Seattle and Philip Bell and Andy Shouse of UW entered the partnership with a shared prior interest in the general problem of helping teachers to learn and teach the content and practices outlined in the NGSS. Bell and Shouse were also interested in exploring research-practice partnerships. They built on a track record of smaller scale design-based research projects, one of which involved Gallagher, who was staff in a different district in the region. Gallagher wanted to be able to build leadership capacity of a subset of the PSEP teachers to facilitate the rollout of the NGSS, but didn’t have the funds. He was also interested in studying and documenting the implementation work but did not have research capacity within his district. Thus, the three of them jointly envisioned the partnership as a way to address a problem they all believed was important, to deepen the work of the PSEP and to explore new ways to connect researchers and practitioners.

The Question of Trust

Collaboratory principles presuppose that research-practice partnerships require trust and some degree of mutuality (“win-win”). They assume that such trust and mutuality between researchers and practitioners can be difficult to achieve and easy to lose—thus the interest in cultural exchange as a mechanism for productive research-practice partnerships. The questions of interest are *How is trust established and maintained? What are its sources? What are the means of strengthening trust? What are the contributors to mutuality?* In this section we explore key elements that created the trust and sense of mutuality leading to establishment and evolution of an effective partnership.

A critical mass of leaders with backgrounds propitious for boundary-spanning

The idea of cultural exchange assumes in part that individuals identify and position themselves primarily as belonging to one or the other culture—researcher or practitioner. The question is how people with boundary-spanning capabilities—i.e., people who are institutionally “bi-cultural”—can

form new kinds of in-between spaces and social practices to facilitate exchanges of values and practices and do mutually satisfying work that serves both cultures' aims (Palinkas, et al., 2009).

In this case, several key players appear to be more than culturally sensitive boundary crossers. Rather, they function more like *dual citizens* who are comfortable in either culture—are experienced, competent, understand the rules and core values—but happen to be living in one culture rather than the other at the moment. For example, Dan Gallagher, who led the way in forming the PSEP and integrating the UW researchers into it, began his career as a research scientist. He then participated in the world of education as a high school teacher and university-based education researcher, and he now holds a high level position in the practitioner world. He is experienced and equally competent as a researcher and practitioner; in fact, he has published education research (Penuel, et al., in press). His limitation as a practitioner is not in his identity or skills; rather, it is the structure of his job and district funding that prevent him from carrying out education research. He is a research-seeking practitioner and also a researcher-seeking practitioner. He has chosen to reside in the world of practice, and entered into this partnership with a well-formed view on how researchers and research can serve his needs and make his work as a practitioner more effective.

Andy Shouse on the UW team was a teacher who became a researcher. Tana Peterman and Kerri Wingert, graduate students on the team, were both teachers in the past. Tana, in particular, recently taught in the Seattle district and describes herself as a “teacher at heart,” who is learning to be a researcher. She entered the partnership more at home in the classroom than in academia.

Researchers' and practitioners' stance and beliefs about research

Those on the research team believe that while it is helpful to have been a teacher, the bi-cultural experiential background is not all there is to the story. Perhaps even more important, from the research side, is their “stance” and “underlying theoretical worldview” and beliefs about research. Here a UW researcher explains that academics who have no teaching experience can nonetheless resonate well with teachers:

Philip Bell was never a classroom teacher, but he knows how to talk to teachers, and he gets the task that they are up to because he has looked at learning very closely in classroom settings, and he takes a stance that is resonant with teachers.

This researcher goes on to explain how researchers within academia live in “different worlds” from one another, and that some believe in collaboration with practitioners and some do not:

Some of it is just your underlying kind of theoretical worldview. What do you believe about research? I think there are researchers to this day who live in a different world, who would be adamant that the thing that you build in a collaboration should be studied by someone else exclusively. I hear people say things like that and it makes absolutely no sense to me, but it is about control and bias and all of those kinds of things that matter to their worldview and that, I think, are way less important in some ways than understanding the phenomena.

Thus, just as not all practitioners feel alien in the research world, not all researchers lack facility in the world of practice. In either world, one's cultural experience together with one's “worldview” about research-practice collaborations matter a great deal.

Establishing trust through ambassadorship

Dual citizenry and shared worldview do not guarantee trust across a complex set of partners. For example, there was no prior relationship between the Renton District administrator Monica Chandler and the UW research team. Thus there was a need to build trust from the ground up. This was accomplished through two means. First, Gallagher—who was already trusted by Chandler through similarity in district leader role and prior working relationship—“vouched for” the UW team based upon his prior experience with them. Gallagher served as the go-between, or ambassador, linking practitioner and researchers who were new to one another. Second, the researchers made good on the promise of their trustworthiness through their stance toward research and the partnership (discussed further below).

Gallagher has continued to act as ambassador in contexts beyond the PSEP project, again vouching for the research team. For example, one UW researcher described the way that Gallagher brought UW researchers to a Seattle Housing Authority meeting, where he worked to “extend trust on behalf of others, to sort of broker relationships.” The researcher reports Gallagher did this:

by saying, ‘you all don’t know each other, but I want you to know that I know all of the people here, and we have these relationships and these histories and there is trust, and I want you to understand that when these people [researchers] talk, listen,’ I think basically what he is trying to broker is there is a bit of a jaundiced view of what researchers do in schools among the people around the table, among the practitioners, and he is trying to help them see that we can bring added value.

Sustaining trust through decision-making that creates mutuality of benefit

Once trust was established (or renewed in the case of those with prior relationships), it needed to be cultivated through ongoing ways of sustaining that trust and advancing mutuality of benefit. One leader said:

...if you take the attitude of yes, we have the right partners at the table, and we all like each other or even professionally we will work well together. But that is at day one, and you have to continue to make sure that you manage that.

The design of the quarterly leadership meetings among the partners turned out to be a primary vehicle to sustain and continue to build trust at the partnership (leader) level. One person in the practitioner position explained that the meetings have become more “disciplined” over time in making sure that each person’s and institution’s needs are met, for the well-being of the partnership and of each institution and partner:

We have tried to become more formalized in a sense of being more disciplined to make sure that we are paying attention to each other’s needs. In our quarterly leadership team meeting now, the leadership team is... a lead from each institution. Then one of the standing items is to go around and ask, are you individually and personally getting your needs met in a partnership? Is your institution getting its needs met in a partnership? How are we helping you with that? Collectively, are our partnership needs being met? We make sure that we give sufficient time to talk through each of

those. And we commit to each other, not just to the health of the partnership, and help each other's problems to the extent that we can.

Furthermore, all of the activities of the partnership are designed and planned jointly by teams that involve both researchers and practitioners. Like the leadership team meetings that address the needs of each group, the planning meetings promote relationship and invite each member to bring the strengths and needs of their “niche” to the discussion. Here a UW researcher whose role is to work closely with classroom teachers describes the combination of personal and professional elements that go into the collective planning of the PD sessions:

The framing meetings are important for getting the PD off the ground...I think there is a lot to be said for feeling that we have hit our stride as a team of facilitators. When I walk in the room, I know that either Gilda or Mary Margaret is going show up with the coffee and that is how it works. B is going to talk to me about his biking and Andy and Phil are going to show up and deliver the research piece of something. Tana and I are going to tie stuff deeply into practice, and Dan is going to give the administrative, make sure that we are adhering to the terms of our agreement. We all have more established goals and I think that has really helped us gel especially at the end of PD. Now others may have felt this gelled more quickly for them, but because I joined in October, it has taken me just this long to feel like I have a niche as well as understanding the niches of others. That I think is a really important part of our planning process.

Informal conversations where partners check in and speak candidly about problems deepen the trust cultivated in the formal leadership meetings. Here a researcher comments on how working together over time has led to more mutual understanding, and how adding a more personal component can add to the trust:

We have been working with [practitioner] for a long time and he is really smart and he understands our world and we increasingly understand his ,and there is a lot of mutual respect ... We will go out and have a beer and just laugh and blow off steam sometimes. I think that is part of it. ...we may not even talk about work and we may get to know each other a little bit more in an informal setting. I think that really pays dividends in terms of when you sit down at the table, you build trust.

Deepening mutuality as the partnership evolves

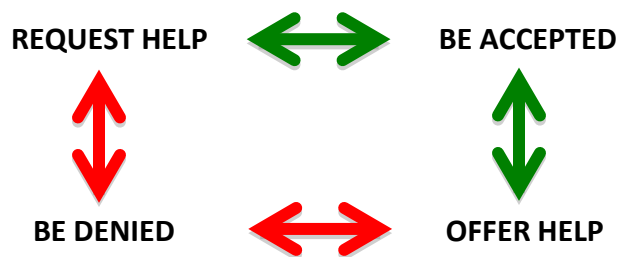
In Year 1, an independent consultant provided much of the content expertise for the professional development sessions. When this person was unable to continue with the project in Year 2, the district partners faced a real dilemma about how to replace him. Though they had built some internal capacity over the year, they felt they would still need to “contract out” the content expertise, especially because the continuing cohort of Seattle teachers would require more sophisticated content and the PD would need to be differentiated to support a new cohort entering the program. Through a series of leadership team meetings involving the UW leaders, it became clear to the district partners that the UW team had the capacity to play a much larger role beyond general advising. In Year 1 the UW team had brought on graduate students with a high level of relevant content knowledge, skill in working with teachers, and institutional “bi-culturality,” i.e., comfort in worlds of practice and research. With this increased capacity in evidence, the research team was invited to step up their role as a more full partner. They drew upon their large professional network to suggest the name of someone who could hire on as new project coordinator (to relieve the district partners of

that responsibility), helped design the increasingly complex PD sessions for two cohorts, and designed and delivered rigorous PD content.

As one district partner described the research team, “these are the right partners and they have access to a lot of deep access to resources, and I mean resources broadly.” A UW researcher said, “We went from a sort of background advisory for the summer work to full on partnership and are taking leadership in providing content, in addition to more broad design input of the process.” In recognition of the new role, the district partner decided to steer some PSEP funding toward them, adding their logo to materials and in other ways formally acknowledge UW as a full partner.

Here we see a partnership where the fundamental cross-institutional and inter-personal dynamic is one of *invitation* on the part of practitioners, complemented by *willingness and capacity to help* on the part of the researchers. We believe this fundamental dynamic is key to productive and mutually satisfying research-practice partnerships. In the diagram below, we lay out the four potential social dynamics related to “helping.” Green arrows depict mutually satisfying dynamics, and red arrows depict unsatisfying dynamics:⁵

Figure 1. Social dynamics of helping



In more traditional RPP relationships that may lack trust and mutuality, researchers and practitioners often find themselves in unsatisfying positions, e.g., practitioners feeling *imposed upon* by research models and researchers encountering *resistance* from practitioners. In the following, a practitioner in the Washington partnership explains what can commonly go wrong when researchers impose models rather than address practitioners’ felt needs:

One of the things I have to say that I really appreciate about [RPP university researchers] is that they come to the table, they come from a place of support and not a place of ‘here, we are going to tell you what we think you need to do,’ but instead ‘we want to learn about this project that you are doing and ... where are the places that we might be able to provide support for you?’ I am pretty picky about who I partner with, and over the course of the last 3 years, [a different group of university researchers] have tried to partner with us, and I frankly have backed off of that because it is always like ‘here is our model that we want you to do,’ and I am like ‘I want you first to hear our context before you tell me what it is that you think you can bring.’ And I just feel like [RPP partners] are very respectful in that regard.

In this partnership, the sustained trust and decision-making processes of the partnership led to a deeper relationship where practitioners asked researchers for specific help and researchers had

⁵ From personal communication with sociologist of education Judith Warren Little of UC Berkeley.

capacity to provide what was requested. The researchers, in turn, gained continued access to program activities at the PD and classroom level to further their development of STEM teaching tools and extend their implementation research. As a result, the trust deepened even further, as did the satisfaction of “win-win.”

A “story that we need to tell”: The Onus Is on Researchers

Even in the highly favorable climate of this PSEP/RPP—where the practitioners and researchers initially met with shared history and interests—the researchers feel that they bear the onus of what one described as “going the extra mile” to sustain the positive relationship. A UW PI said the following about what it takes to create a truly constructive research + practice relationship:

I think a story that we need to tell as the Collaboratory is about the stance that you have to take if you want to engage in this kind of work and the many, many opportunities that you have to foul that up. To pull it off and to escape being viewed as an interloper, we bend over backwards to try to be helpful and to be respectful, and we still probably screw up some times. But I think this whole permission-getting process with the district was incredibly important and the constant need to explain what you are doing and to bring people into the conversation and extend invitations to them is something that I would like to get on the table. I think it is the part that we have to tell to our colleagues about what it means to really partner, and it includes a number of things that I don't think are always understood, from providing coffee when the district can't figure out to spend money to get coffee for teachers, to offering to put together slides for the board meeting when some grumpy board member is asking about science or math or something we can quickly give them some information about. There is a bunch of that kind of stuff going on, all of the time.

III. THE INQUIRY OF COMMON INTEREST— ITS DESIGNATION AND EVOLUTION

In literature on design-based implementation (DBIR) research projects, considerable attention is given to the focus of the work and how that focus is negotiated and defined (Penuel, et al., 2011, Coburn, et al., 2013). In fact, a core challenge of research-practice partnerships is to focus the work on “persistent problems of practice” that are truly grounded in what is relevant to practitioners. In the Washington RPP, the partners seemed to agree readily on the initial problem domain and also seemed to share belief in using close observation of teachers’ attempts at implementation as the means to continue to refine understandings about problems of practice over time.

Prior shared interest in a problem area

Gallagher of Seattle and Bell and Shouse of UW entered the partnership with a history of shared interest in the general problem area of NGSS implementation, specifically the Practices. Gallagher took the lead in identifying argumentation, explanation, and engineering solutions as good starting points for because he thought he could make progress on them. Thus those areas were front and center when he applied for the MSP. (Argumentation and explanation overlap with the Common Core.) He drilled down to the idea to begin in Year 1 with a focus on adding argument to existing

curriculum because he felt it was both an important and accessible starting point for teachers. The Renton team readily agreed with and signed onto Gallagher’s focus on the problem area. Classroom teachers we interviewed in both districts also confirm that structured support for “transitioning materials” and learning about “best practices” is critical to their implementation of NGSS.

In series of conversations with Gallagher preceding the first summer workshop, the research team from UW explored what role they might play, with an emphasis on how they could be helpful, e.g., offering their expertise to shape and deliver some of the content workshops, supporting teachers in making curriculum adaptations, and generally being good listeners and helpers as the practitioners defined the work they wanted to do. One research leader described the initial situation:

They [the districts] have an effort funded, they have to deliver on their timeline and milestones, they have their strategy generally in place, and they are trying to figure out the specifics. We [the research team] were talking about how having some of the assets of the Collaboratory on hand could be useful to them... We are also finding our way into that conversation, and so it is not fully realized yet on the planning side.

Even with the initial shared interest in the work and its focus, exploratory conversations among the practitioner and researcher PIs took place over an 8-month period before the first meeting with teachers.

Evolving identification of problems of practice

While the problem area for the work was defined early as part of the establishing PSEP, the research team and the district (practitioner) leaders closely observed the work of teachers during the first year to help them address their *particular* problems responsively via the PD component of the project. A district PI explains how he wanted the PD to respond to the actual problems teachers faced rather than putting teachers through a prescribed three-year sequence:

We have been paying attention to these emerging problems of practice that teachers have been talking about, and we want to respond to those and address those rather than say nope, we have done our plan, we just [follow it] and repeat all 3 years. And so, some of those [emerging problems of practice] are giving a little more specific attention to assessment in engineering, and supporting English language learners in argumentation and explanation in engineering.

Researchers and practitioners collaborated on designing and delivering PD sessions to address these teacher-identified challenges.

The researchers observed teachers for the additional purpose of identifying a more focused design-research agenda for themselves. In other words, within the general problem of implementation, they looked for more specific problems of practice to frame their future work. One lead researcher described it this way:

I think it is fair to say that we have spent a lot of the [first] year in a dance to try to figure out the research agenda. The dance started with the [PSEP/state MSP] summer workshops, a couple of different opportunities for us to engage with the participants, where we came in as sort of the new participants in an existing, but then still pretty new project. Saying hey, we are here, we want to add

value to what you are doing, we are interested in research related to the implementation of NGSS broadly, and we want to engage in kind of a design-based collaborative approach with you. Here is a menu of things that we would like to do that would be both an opportunity for us to support you and an opportunity for us to collect data...And then over the academic year we worked to figure out where we could get ourselves situated, where we could learn how the implementation is going, what are the central problems of practice that teachers are responding to, and how do we start to document their efforts and development related to the implementation of their practices?

IV. FOCAL POINT: THE RELATIONSHIP AND INTERACTIONS BETWEEN RESEARCHERS AND PRACTITIONERS

In this section we examine researcher-practitioner interactions at two levels: 1) at the leadership level, among district administrators and the UW PIs, and 2) in the classroom, where there are interactions between UW graduate students and teachers. Constructive interactions at both levels are vitally important to the sustainability and effectiveness of the partnership, given the multiple layers of context that constitute the world of practice. As one UW researcher said, “the district culture is one thing and the building level culture or even a classroom culture obviously can be very different.” Interactions are designed such that researchers continually position themselves as being directly helpful to practitioners while at the same time generating research questions and products that will be valuable to their own research agenda. It is important to recall here that researchers’ “theoretical worldview” drives them to seek out mutualistic practices of partnering out of belief that such practices help them better understand problems of practice worthy of research.

Leadership level:

Devoting specialized research capacity to benefit practitioners sooner rather than later

An important core practice within the design of RPPs is to synchronize the timing of research to meet practitioners’ needs. Penuel, et al. (in press), point out that, “The syncing of timescales between researchers and practitioners is especially difficult to accomplish, as researchers typically produce research much more slowly than practitioners need it to inform their practice.” The anecdote we offer here shows how a quick turn-around research study conducted by UW researchers served district-level practitioners’ immediate needs while advancing their own longer-term research agenda.

One district partner faced a political challenge in the district related to the value of teacher-to-teacher sharing as an approach to spreading implementation. Predecessors had relied on a centralized system that limited teachers’ access to new materials, discouraged teacher adaptation, and did not promote teacher-to-teacher sharing of new curriculum and strategies. In contrast, this district leader wanted to promote a new district “ethos” to coincide with the implementation of the curriculum adaptation project:

In PSEP the ethos is, we are building these material resources, curriculum materials for all [district] teachers to access and use. And I am not claiming that once the thing is there, all teachers can use it—it obviously makes the most sense to teachers who have been involved in the design. But we are

still building these resources that weren't there before...and teachers are finding ways to use them with their colleagues.

As he promoted this “ethos,” however, he had no evidence that teachers were enacting that ethos or believed it was of value. Thus he faced a political problem as a new person in the administrative position. When, toward the end of Year 1, the UW researchers began to observe that teachers they worked with in “deep dives” (see next section) were collaborating with their colleagues, this district partner began to see the possibility of securing evidence that could help make the case for the new ethos to district higher-ups:

We had that sort of ethos, but we couldn't verify to what degree it was actually happening. Are teachers using it with their colleagues? That led UW to take a social network analysis approach to teachers' interactions. I would say that they responded to my goals as a leader in [the district] and a vision for the program.

He adds that this study was not pre-planned, but rather emerged from the year's observation in classrooms:

That was not at the beginning of the project—here is what the research program might look like. It just emerged towards the end of last school year... So now we have seen evidence that indeed, other teachers who aren't formal PSEP participants are learning and are accessing new resources through PLCs in our buildings, through principals giving staff meeting time to participating teachers to share with their building, and through lots of other informal ways that show up on our social network analysis.

The empirical analysis has helped him make the case both for his general ethos of teacher learning community and for the success of PSEP as a partnership:

I then use some of that data when communicating to higher-up leaders in Seattle to say, this is the impact of this partnership in service of providing more access to resources for our teachers...I point out that this is not a conceptual diagram, this is empirical—this is a representation of data and this is what is actually happening!

This practitioner is especially appreciative because the district does not have the capacity, in either expertise or time, to conduct such a study:

This is one of the ways that I really appreciate partnerships—that [study] is not something we, or any other school district, have the resources to do, that type of analysis that fuels broader vision work. So that data, when done in that way, is invaluable.

The study also benefitted the UW team. The discovery of this pattern of teacher networking began to provoke more questions, pointing to an emerging new design-based research project. One researcher described it the following way:

We want to understand the social network involved in the professional development effort and how teachers share information, either broadly or intimately. There is an idea afoot to potentially use design based work to complete areas of the network where there might be isolated teachers or teachers who don't feel like they get access to resources via social or other ways, and so that is something that we are planning to think about in the next few weeks.

Here we can see how research-practice relationships that are ongoing and characterized by trust and mutuality can become generative in an ongoing, cyclic way—feeding research to practice when it is needed, and spawning new research efforts.

Classroom level:

“Deep dives” involving teachers and researchers

Graduate students from the UW team have been working in classrooms with teachers at the elementary level in Seattle and at the middle school level in Renton. This in-classroom work began in Year 1 (2013-2014 academic year) and has continued in Year 2 (2014-2015). Referred to as “deep dives,” this work is characterized by a working partnership between a UW graduate student and an elementary or middle school teacher. In terms of people involved, the scale of this work is small. In year two, two UW researchers (graduate students) each worked with one elementary teacher, and one graduate student worked closely with two middle school teachers (who teach the same grade level and have the same planning period) and also supported four other middle school teachers, three regularly and one occasionally.

Forming mutually beneficial researcher-practitioner partnerships

At each of the summer institutes, the UW team invited a small number (2-4) of teachers to participate in these deep dives and explained the nature and purpose of this work. The first summer, in an attempt to be flexible and helpful, the researchers laid out a menu of options for the work that the teachers found a bit overwhelming. The teachers who signed on were characterized by the researchers as confident and experienced at working in some capacity with researchers or having researchers in their rooms.

The second summer, the UW researchers had a year of experience under their belts, and when inviting teachers they were able to be clearer about the nature of this work, the role of the researcher, and the intended nature of the relationship between the teacher and the researcher. Furthermore, the researchers reported that several district staff also spoke supportively about the work to the participants, again following on a year of experience:

We had two teachers who we worked with last year stand up in front of the whole group and vouch for the work and say it was really useful for them last year. Dan [Gallagher, the district lead] also said that in front of the group. And then in the middle school group, one of the teachers that I worked with last year said the same thing to the middle school teachers. So I think that, at least in the middle school, it has made a big difference, and I think in the elementary schools, too.

Just as has been the case at the leadership level, an invitation to join a research-practice partnership can be more attractive, and trust between researchers and practitioners can increase, when practitioners “vouch” for the positive nature of the interactions and results.

Joint inquiry from the perspectives of both research and practice

The work begins with the graduate student and teacher meeting in the fall to discuss how things are going in the classroom, when the unit with the adaptations will be taught, what the teacher is

interested in working on, and how the graduate student can support that work. Thus the focus of the work in the classroom is carefully determined ahead of time by the teacher and the graduate student and is driven by the teacher's interests and priorities.

The graduate student then visits the teacher's classroom, sometimes beginning before the unit containing the adaptation is taught in order to get a baseline sense of the classroom. The graduate students describe their role in the beginning as "participant observer"—they observe the classroom and take field-notes, and they make themselves useful by helping with implementation, especially working with students individually and in small groups as lessons unfold. As the work continues, researchers become involved in co-design and implementation and also begin to videotape the classrooms for their own data collection (after the UW team has received IRB approval and the parents have given their consent). The graduate students describe the process as follows:

When it comes to working with focal teachers, I try to sit down with them before I come into their classroom and say, 'now, what are you curious about or what do you want help with?' so that we can be working on something together.

I would just ask, 'can I come watch what you are doing?' They were all open to it. Then the more that I would be there, the more we would just start talking about, 'well what is going on in the classroom?' A teacher will anecdotally tell me right after class, 'here is where I am struggling with this part of the implementation.' Then, it just leads to other conversations, and then I started staying for some of their planning periods.

Teachers we spoke with confirmed this process, and reported that it felt very respectful, using terms like "non-invasive," "organic and natural," and "helpful."

The inquiry is structured to be shared: the researchers get involved in the classroom implementation, and the teachers get involved in reflection on problems of implementation in a dialogue resembling that of a coaching model. For example, one researcher is working with an elementary teacher to implement the student explanation strategy that the project refers to as the Claim-Evidence-Reasoning (CER) framework. This framework was created for the teachers as part of the PSEP agenda of helping teachers adapt their units to address NGSS Practices #6 and 7: Constructing Explanations and Engaging in Argument from Evidence. The researcher explains the work:

I've been working with her to implement some student explanation strategies. The students did a first draft of an explanation [regarding data from the unit] and it was pretty phenomenal. I'm excited about the results because so many students who are bilingual or emerging bilingual students were really able to engage. I'm going to go back and do a closer look and analysis of what actually happened in the classroom because I was helping [the teacher] teach, checking student work, helping engage students in talk as they were trying to write, and encouraging them—'really good scientists tell us what they know about science and make it crystal clear.'

The graduate students then put their field notes in Google docs and make them available to their teacher partners. Here a researcher explains how she frames her field notes as coaching to be helpful to the teacher:

My field notes are more in the style of teacher coaching, where I say, 'here is what I saw,' and 'here

are the science practices that you employed’...and ‘when you did this, students responded like scientists’. Sometimes I include notes of things she might not have seen, for example, I keep an extra eye out for bilingual kids and how they are engaging, and then I ask questions like, ‘have you thought about ways to get kids talking more?’ or ‘have you thought about, if you do this again next year, how this will be a great chance to implement blank?’

Here a researcher describes how a teacher has engaged in reflective dialogue about the questions, interpretations and ideas for future work included in the field notes:

I take my collaborative field notes and create a Google document that I share with a teacher so that the notes are always available to them if they want to look through them...I write my field notes and then embed interpretations or questions or clarifications, things like that, in a color of font, and then she enters a third color of font and responds to it or elaborates on things.

At right is an example of an interchange between researcher and teacher.⁶ The researcher describes what the teacher “RMM” does, reacts, and asks a question (blue font), and the teacher adds her perspective (purple font). CER stands for Claim-Evidence-Reasoning framework.

2:14 RMM referenced the rubric and noted that she hadn’t explained the “science concept” row to students, so they could ignore this for now. My gut reaction was “Noooo!” but I realize I have a different perspective and understanding of the purpose and implementation of this argument activity. I’m curious to know more about RMM’s reflection on this—would you do something differently next time to bring in the relevant science ideas? The reason I didn’t focus on the science concept this time around was: First, we haven’t ever gone over what that part might look like for a CER. Second, in years past this seemed to actually be the hardest science concept for students because it seems obvious to them that they can’t write well enough about it. RMM talked about how different students preferred different formats from their CER. She also referenced the sentence starters on the back of the rubric document.

The teachers who worked with the researchers also commented on the process and its value to them. One teacher said she used the field notes in

her teacher evaluation file. Teachers appreciated that the researchers wanted verification of the field notes’ accuracy, and they were curious to see what the researcher noticed as interesting or important, often comparing to their own perspectives. Ultimately, the teachers found the task of reviewing the lengthy notes time-consuming, and they did less of it as time went on. Here is one teacher’s comment:

“[the researcher] shares all of her field notes because if there was a mistake made, or an area where she didn’t quite get the notes down, then I could verify them with her... It was a lot for me to constantly look over, and so I didn’t really look at them later on.”

In summary, the explicit purpose of this work is to support teachers in the implementation of the adaptations they have made to their units. The deep dives also provide the UW team with classroom data for their research questions. Thus there is a clear mutuality of purpose and benefit.

⁶ Washington researchers agree that this was an especially powerful joint practice; however, they could not sustain it at the level of the original intent. Thus we offer it as an example of partners-in-research rather than as a common practice.

Defining and responding to persistent problems of practice through collaboration

Because the UW researchers are inquiring into the problem area of NGSS implementation, they bring a genuine interest to learning from teachers about the problems they face in adapting curriculum and embedding new lessons into their repertoire. The classroom-centered collaborative inquiry between teacher and researcher in the classroom thus surfaces particular areas of difficulty encountered by teachers as they implement their particular adaptations. These become the “persistent problems of practice” that the researchers and practitioners focus on. This in turn drives the development of new content for the teacher workshops and of new practice briefs. One researcher said:

We have seen so many teachers talk about argument and explanation and engineering in class. We really are learning what the hard parts are about teaching teachers those two science practices, and I think we are really honing our expertise on what might go wrong in which unit when teachers want to do an argument or an engineering task.

Because the deep dives provide a window into daily issues that arise in classrooms related to the new adaptations, the project can respond with relevant professional development that serves teachers’ needs. For example, midway through Year 2 it became apparent from the middle school classroom work that teachers were struggling with the Claim-Evidence-Reasoning scaffold: the approach was stale, no longer pushing student thinking, and they were ready for a new strategy. Here a researcher reports on how the implementation issue became a professional development opportunity:

There was one week in December where I was in a couple of classrooms and also met with some other teachers, and all of them said they were sick of the scaffold and/or their students were sick of it. That was the driving thing that made us realize as a team, okay, that is awesome because now our teachers and the kids are ready to extend what they do related to explanation, argumentation. That was the main focus of the January session—the CER framework has some great entry points, now what? What are some different things that we can try?

A district partner recalled the same moment of recognition, crediting “the deep interaction between UW staff and in particular working with the teachers” for informing the leadership team that it was time to move the PD another step forward. The team responded, revising the PD in response to teacher concerns. The graduate student who had been working closely with the teachers facilitated a large part of this session, again helping to cement the partnership. Moreover, UW committed to creating a “practice brief” on argumentation (referring to the CER framework) and adding it to their growing collection of STEM Teaching Tools (<http://stemteachingtools.org/brief/17>). For this, they involved another researcher/teacher at UW not on the RPP team but who had the right expertise.

By choosing to address teachers’ real and immediate needs, PSEP (and the adaptation site) has fostered a strong working relationship between researchers and practitioners, built on good listening and trust. Here a researcher describes the importance of anchoring the relationship and the work to the problems of practice that practitioners actually experience, and of avoiding the temptation to “push some other direction”:

Our work brings to bear the importance of recognizing problems with practice that practitioners are already dealing with, and the importance of taking all of that into account when working with them, because I could have easily tried to push some [other] direction. But it is so clear that if that happens

we are going to lose the relationships we have with teachers. I guess another part of it is the importance of building trusting relationships and having something to offer the teachers as well, just having research knowledge...and being able to make that time to work with them and follow up.

We note here that teachers who worked one-on-one with researchers were aware that the researchers' study of their work and listening to their concerns informed the content of the PD. Teachers who did not work one-on-one with researchers could observe that the research team often delivered the PD content; however, it was not apparent that the PD content arose at least partially in response to problems researchers and teachers identified in classrooms. To teachers not involved in "deep dive" relationships, the PSEP PD was not distinguishable from other PD.

Embedding practice-sensitive research into the partnership

The teacher-researcher partnership that is enacted through the deep-dives creates a context where research knowledge and expertise can seamlessly enter into and contribute to the improvement of practice. Because the researchers become so attuned to practitioners' problems, they can draw from their researcher knowledge base in highly specific and strategic ways to inform teachers. Designing a new professional development session to move teachers beyond the CER framework when they were ready is a case in point. The researchers designed and led that session because they had the background knowledge, gained from research, to bring to bear on the problem. Further, the researchers could target their development of other, more far-reaching, research-based products on these problems, based on the assumption that the problems of practice that Seattle and Renton teachers face with NGSS implementation are probably not unique to those districts. Here a researcher describes how they listen carefully and "tag" problems of practice that they can then address through the spread of research knowledge:

We are consistently listening in all of the PD with our conceptual tag of "implement [NGSS] practices," to write a note and tag it so we can go back and address it. Usually the way it gets addressed is it is brought up on the spot and discussed in the open, or we help design more PD around that problem. We might spend a couple of hours planning for it at the district level because sometimes they are messy. We might write a practice brief about it if we think that it is something that is more broadly problematic.

Below, a researcher emphasizes a key value within the partnership, which is that the researchers do not share research with teachers to try to remedy a researcher-identified problem; rather, they bring research to bear to help solve problems that teachers identify from their work with students:

We have a lot of avenues to look at to address those problems of practice that we hear about, especially the ones that practitioners bring up, because if they bring them up, that is a lot more original and real for them than if we say, 'oh look at this teacher, they are not doing X and we need to remediate that.' That is not the way we do it.

She adds, "I rely much more on my experience and training as a teacher leader than a researcher to address those kinds of issues."

Teachers who volunteered to open their classrooms to researchers were rewarded with customized support. Here, a teacher describes how the researchers served as "translators" of current research:

...their ability to provide the resources and the strategies that teachers need and in a way that translates the academia, the current research going on, into what our teachers can actually use in the classroom ...[researcher] has been a great conduit, or more like translator, by having one foot in academia and having stuff that is pretty much for the classroom.

Co-developing tools for STEM improvement

Just as researchers have been invited to play a role in co-developing the curriculum adaptations, the researchers have invited some teachers to play a role in co-developing the research products and tools led by the UW team as part of the Collaboratory work.

We have invited some [teachers] to our Inquiry Groups in the past and have been active in asking teachers to engage in our development of STEM teaching tools [e.g. practice briefs]...Those have really taken off this year.

Much as the co-construction of field notes for the classroom could not be sustained, this co-development process for the STEM teaching was not sustainable. In the early stages, UW researchers reported that one PSEP teacher served as co-author. One administrator we spoke with contributed to some early tools, and one teacher had reviewed a draft of a practice brief, but others had had no role. While the research team reports wanting to “do more of that,” the reality is that most STEM teaching tools are developed by UW researchers, mostly graduate students. Nonetheless, the problems of practice they focus on derive from researchers’ inquiry into real classrooms and consultations with teachers.

Expanding a research agenda grounded in immediate problems of practice

The social network analysis described in the previous section began to expand the UW team’s research agenda toward an inquiry into what one researcher described as “how information travels through networks of teachers.” In the comment below, a UW researcher describes two additional research foci beginning to arise from the partnership:

Another question is ‘how do researchers and practitioners work together to create systems that help change trickle through systems?’ Also the equity agenda for students has become more prominent this year because we are spending more time in classrooms, and [colleague] and I both have backgrounds teaching in under-resourced communities, so that is a leading edge, and it is a deep part of the philosophy of our [UW research] center. I am not sure that was explicitly on the table a year ago, but it is now.

Three of the four graduate students on the UW team see these new areas as potential dissertation topics.

A research-practice meeting ground

The “deep dives” and the PD workshops, in particular, have become meeting grounds for cultural exchange among researchers and classroom-level practitioners. A UW researcher describes their work with Seattle and Renton in ways that reveals what is probably a key feature of this RPP meeting ground—asking people with different backgrounds and assets to “fill in where they see they can”:

I really do think with my whole heart that it is a solid case of how researchers and practitioners can co-design and pull off large-scale system support and change without asking anybody to be something they are not. Everybody gets to fill in where they see they can.

V. SUMMARY OF BENEFITS FOR PRACTITIONERS AND RESEARCHERS-IN-TRAINING

It is beyond the scope of this case study (and the role of Inverness Research) to assess the longer-term and more distal contributions of the partnership—either from its model and practices or its products and their impacts. However, we can see that both practitioners and researchers have benefited in multiple ways.

Classroom teachers who had opportunities to work directly with university researchers benefited in many ways. Teachers gained new knowledge and skills through the opportunities they had to reflect on the effectiveness of curriculum adaptations alongside UW researchers. The researchers “helped teachers understand their practice as it unfolded in real time and how it is affecting students,” a process that involved “a lot of looking at student work with teachers in the moment” and providing “quick turnaround summaries of students’ conceptual knowledge as well as their practice engagement.” This enabled teachers **to make their own inferences about the new practices as well as learn from outside expert perspectives.**

PSEP’s particular strategy of “deep dives” into classrooms meant that teachers who volunteered to open their classrooms enjoyed **a professional opportunity they rarely have—the presence of an astute observer who:**

- was well informed in both research and practice
- adopted an inquiring rather than evaluative stance
- helped out where invited and needed
- focused attention on student experience and learning
- supported the teacher in reflecting on the quality and efficacy of the lesson
- helped trouble-shoot rough spots in the lesson
- provided resources for the next iteration.

We spell out these features because they stand in stark contrast to what most teachers typically experience and are so in line with what many teachers want. Here are one teacher’s words:

I don’t have very many people observing me ...I don’t get very much feedback. So I liked the opportunity because I felt like she wasn’t there to judge me, she was there to get data, and so that is even nicer, because normally when I do get observed, someone is evaluating me ...I can get some ideas and hear from her what she sees...I really liked getting feedback about specific groups of students that she would focus on...just getting different ideas for ways to do the different activities.

Perhaps the most important implication of these teachers' comments is that **this RPP relationship revealed a gaping vacuum in many teachers' professional lives**: the availability of sensitive, highly skilled observers who want to be helpful and to learn about implementation of new practices. The relatively small number of teachers who were part of the class visits and close collaboration were able to share their new knowledge and experiences within their school-based learning communities:

A lot of changes that were tried with our research classrooms have spread to our other classrooms.

District administrators also benefited in a number of ways, all of them related to their role of supporting instructional improvement. One pointed out that having trusted outside researchers—rather than district administrators—in teachers' classrooms **created a safe space for teachers to open up their practice and learn to examine it critically**:

Having somebody who is really an outsider partnering with us is, I think, sometimes easier for teachers to open their classrooms and to let [UW researchers] in. I don't have anything to do with teacher evaluations, but there is still a perception that I represent 'the district'.

Administrators also benefited, as noted earlier, from **the broader knowledge base the researchers bring** in the form research-based articles and professional development workshops in direct response to the issues that teachers were facing in their work. One administrator said this:

[UW researchers] work all over the country and see what other districts are doing, and so they bring a different lens and a different experience and a different level of expertise... This partnership has been very responsive to the context and to what we describe as the needs of our teaching staff and our students, so it feels like it has been really beneficial to our learning and to theirs.

Further, the STEM teaching tools produced by the partnership **preserve much of that research-based knowledge in a format that makes it usable** by district administrators and teachers into the future, beyond the PD session. One administrator commented that the **STEM teaching tools are at least as good and probably better than other resources**:

The STEM teaching tools are useful because they are on point. They are useful because they are just the right length and sort of a supplemental handout on a topic, just how they are designed. If you want to learn more about X, here is something to launch from... This kind of STEM teaching tool as a product potentially has more value than some other research based product or resource because it came out of a collaborative project.

This same administrator speculates that **practitioners more broadly may benefit** from products of the partnership by suggesting that **the overall return on investment in this kind of collaboratively developed, research-based resource for instructional improvement is greater than the return on investment in traditional research products** such as journal articles:

When you think about return on investments, I think the return is definitely greater on the investment with the STEM teaching tools... If you go back to these [other than UW] experts in modeling, they have put their careers into that topic and they have produced maybe a handful of [journal] articles. That is a pretty big investment that the system makes to try to get resources out of that [traditional research]... Practitioners aren't going to wade through or even have access to something like JARST, and so it's a pretty limited amount of resources that directly respond to what

teachers are asking...Here, the UW team is covering a wider range of topics and they are pretty accessible...In the span of just a few years, they are being used much more, and I would say, you have already gotten from the system a much, much larger return on that investment.

University graduate students, as future academics or professionals in other spheres, also benefit in multiple ways from this kind of partnership. Most immediately, they experienced the **satisfaction of seeing the results of research enter practice**. While many researchers feel a chronic dissatisfaction because their research is not “taken up” by teachers, the researchers in this project had the contrasting experience of seeing immediate results because they had drawn from their combined practitioner knowledge and research knowledge to help teachers solve immediate problems. Here a researcher describes the joy of getting immediate positive feedback:

In the majority of educational research, you spend most of your time outside of the world of kids learning, and that is lame to me. Getting to actually see how it is working and not working—and the not-working stories are the most exciting—and to get to see when something gets pulled off is amazing. When we taught this CER (claim, evidence, reasoning) lesson on Tuesday, we had kids writing and explaining scientific principles that I had no idea that they had even soaked up, and so to be there to see when it goes through really well is awesome.

The Local Lab of the Collaboratory offered a **valued alternative foundation for their training as researchers**—a methodology where classrooms, rather than labs, are primary settings for research. One graduate student commented on how the traditional approach to learning research was not a fit for the professional values she formed as a teacher:

When I came to UW I started out in an Ed Psych program that tested kids’ brains in a lab, and it didn’t feel real to me, and it didn’t have any of the wonder or the fun of classroom life in it that I had worked to build as a teacher. This [research in the PSEP partnership] fits with my values and my philosophies of learning much more closely.

Another graduate student commented:

I think it is pretty easy to be in a university and lose sight of what actually happens in schools, and so [working in the context of the partnership] helps keep the research agenda tight and rooted in real problems of practice.

The graduate students feel **well prepared for future professional work as researchers and change agents**. First, they feel they have training in a **research approach where they can make a practical difference in education**. One who is putting herself on the university job market says the hybrid perspective is the “leading edge” of how she portrays the professional contributions she wants to make:

I am using my Collaboratory experience as the leading edge of here is how I not only bring research, but I bring a mechanism for change in the community. So not only do I think of it as a way to get a job, but I think of it as my career’s work—to build partnerships and to conduct research as collaboratives on the ground designed with practitioners as the beneficiaries... This partnership prepared me uniquely to build out a career working with school districts and with communities of teachers in a way that I couldn’t have otherwise done.

Further, they have developed concrete **skills in delivering professional development** that is based on research and is responsive to teachers:

I have so much more experience now, planning PD, facilitating PD, following up with teachers and looking at their feedback, and trying to weave that into the PD moving forward. That has been really huge, and I think that is probably the biggest thing that I will take with me.

One researcher pointed out that **being part of the Collaboratory**—beyond their local lab—**sharpened her training** because of the frequent reporting demands:

I think it definitely would have been different without the Collaboratory because in the Collaboratory it feels like we are held accountable, more or less, to share fairly often what we are doing and what we are finding. If we didn't have the Collaboratory, I don't know that we would have that. I don't know if accountability is the right word, but that kind of desire, that platform, to share within a group.

The graduate students also developed **capacity to share and spread their knowledge about DBIR and RPPs**. One already sees potential interest in her discipline network:

Learning DBIR has been huge... in terms of how do you do design-based research in a very complex school system where innovation is very difficult or innovation at scale is even impossible...I think among my own community of science ELL researchers there is a lot of interest in building partnerships into their teacher work.

Another suggests that their experience co-researching with teachers gives them practical wisdom they can share with other university researchers who may not have the benefit (as they did) of prior work experience in the classroom:

We are really good at working with teachers. I mean, we are not better than other teachers, but as far as research goes, I think we could probably develop a list of things to do and not do when you are working with teachers in schools. I think most researchers would say 'ohhhh!'

As professionals with networks of their own, these researchers can contribute to broad changes in the field.

VI. THE CASE AS ILLUMINATIVE OF DESIGN-BASED RESEARCH + PRACTICE PARTNERSHIPS

The PSEP/RPP is, by all appearances, a “best case” example of a functional and productive research-practice partnership. The Coburn, et al., white paper on research-practice partnerships (2013) helps us frame a summary of key features that make it so.

Key components of research-practice partnerships

The Coburn paper was prepared in response to the William T. Grant Foundation’s interest in the “burgeoning community of research-practice partnerships” in which the “predominant producer-push dynamic of research to practice” gives way to arrangements that “foster reciprocal interaction

in which practice informs research and vice versa” (from the Foreword). The paper outlines five major ways in which research-practice partnerships “differ from the conventional ways researchers and district leaders work together.” Research-practice partnerships:

1. are long-term
2. focus on problems of practice
3. are committed to mutualism
4. use intentional strategies to foster partnership
5. produce original analyses. (p.6)

The intent, design, and functioning of the Washington PSEP/RPP exemplify each of these.

1. **Long term.** The Coburn article states that, “The work can span a few years, or, as is true for some partnerships, more than a decade, shifting focus as the work develops over time” (p. 6). The current PSEP/RPP is certainly a second iteration of earlier collaborative work among the lead Seattle Public Schools PI and the lead UW PIs. Adding Renton to the PSEP expands the partnership and creates the possibility of future collaborations involving both districts. A third and fourth iteration of the Seattle/UW partnership will likely evolve. Seattle garnered a second MSP to extend this work beyond Summer 2015, this one focusing more on the needs of English language learners. Dan Gallagher has reached out to the Stanford Understanding Language program faculty (thus adding to his stable of university partners), and integrated Kerri Wingert, member of the UW research team, into the conversations based on her interest and expertise in language acquisition and equity.

Moreover, Gallagher has engaged the UW lead researchers in discussions with Seattle Housing Authority to explore ways to better serve students in high-poverty areas. If this work continues, it will again anchor to the foundational Seattle/UW partnership and expand to the city agency. In summary, foci and individual players may shift and expand, but the core Seattle/UW partnership continues.

The notable observation here is that for both the Seattle and UW leaders, ***working in partnership reflects a value system as well as a lasting arrangement.***

2. **Focus on problems of practice.** The Coburn article states that, “Research-practice partnerships start with a focus on... issues and questions that districts find pressing and important. They can involve student learning, classroom instruction, or how to organize a district for improvement. By starting with a problem of practice, research priorities are set in response to district needs, rather than to address gaps in existing theory or research” (p7). The PSEP/RPP formed around a shared interest in how to implement NGSS, specifically how to support teachers’ teaching of STEM practices that are unfamiliar to them. Within that shared area, the district took the lead in adopting the strategy of teacher-led curriculum adaptation supported by series of content and science unit-revision workshops. The UW team embraced the district’s approach and offered to help, which signaled their willingness to work in response to district needs.

Notably again, the UW team did not approach this stance as one that caused them to sacrifice their ability to advance research or theory. On the contrary, their own theoretical bent toward

implementation research made them assume that **this collaborative approach would generate understanding not possible through more a positivist stance**. Furthermore, the lead practitioner who formed the partnership is a research-seeking practitioner who assumes that collaboration with trusted researchers will add capacity that the district cannot provide on its own.

3. **Commitment to mutualism.** The Coburn article states that, “Research-practice partnerships are characterized by a commitment to mutualism—sustained interaction that benefits both researchers and practitioners...the focus is jointly negotiated, and responsibility for how the work unfolds is shared” (p.7). The Washington partnership launched on a foundation of trust, including some confidence in mutualism. However, **the partners worked in explicit ways to protect and strengthen the commitment to mutualism, never taking it for granted**. Several examples:
 - Initial exploratory conversations about the UW role lasted 8 months before the project began.
 - Quarterly leadership meetings included specific agenda items where each partner spoke explicitly about the extent to which their own institutional needs were being met.
 - In the classroom, UW researchers listened before they offered suggestions, responded with help that was requested, and invited teachers to comment on and use field notes.
 - Researchers shared their observations of teachers’ implementation challenges with the leadership team, and the professional development design team (including both researchers and practitioners) responded by adapting PD to what teachers needed.
 - Practitioner partners agreed to engage in the development of the research team’s STEM teaching tools.

All of these practices of communication and collaboration helped to sustain mutualism. Beyond these, **the heaviest onus was on the researchers to sustain trust**. They believed that even with all of the positive elements in favor of the spirit of mutuality, they could easily “foul that up.” Going beyond the more explicit elements described here, the UW team enacted a more implicit (but shared within the team) commitment to “go the extra mile” to be helpful and sustain the trust:

1. **Use intentional strategies to foster partnership.** The Coburn article states that, “Research-practice partnerships use intentional strategies to organize their work with one another.” The communication strategies named above are examples of intentional strategies to organize the work. Additionally, as the project grew in complexity, teams were organized to focus on different facets of the work (e.g., leadership team, PD design team, and Web team), and each team included both researchers and practitioners. Another intentional strategy early on was Gallagher’s serving as “ambassador” to bring together the Renton administrators with the UW team.
2. **Produce original analyses.** The Coburn article states that, “Research-practice partnerships go beyond the focus of many current organizations on making data accessible to district leaders. The partnerships instead produce original analyses of data to answer research questions posed by the district” (p. 7). The PSEP/RPP case offers a striking example of this principle. From the beginning, the Seattle partner wanted to promote an “ethos” of teacher collaboration and sharing, a cultural shift from past leadership ethos in the science program. He did not express this to the UW team as a major research interest; rather, he (like they) focused primarily on challenges individual teachers

faced in adapting their units and teaching new lessons. However, as the project unfolded, both practitioner and researcher leaders began to observe that teachers naturally began to share with other teachers in their schools and that some principals began promoting the curriculum adaptation approach beyond the participating individuals. On a year-end survey, the researchers (in cooperation with the district leaders) decided to collect data on the connections among the teachers. The data suggested that teacher networking/sharing may be contributing to implementation.

Here, the UW team stepped in not only to share the data with the district leader, but also to conduct rigorous social network analysis methods to analyzing it. These analyses—and the slides that the UW team created for the district partner—served the district partner very well. First, the analyses gave him important verification in his hopes about teacher collaboration. Perhaps even more importantly, they gave him empirical evidence—backed by the stature of the UW—that he could use politically in his district to advance commitment to his ethos of teacher collaboration. Here **the researchers provided analyses that the practitioners had no capacity to do themselves and which were immediately valuable.**

The PSEP/RPP as an example of Design Research

Within the Coburn taxonomy of district-university partnerships there are three types. One is “Design Research,” which is characterized as “similar to engineering research” in that “the aim is to build and study solutions at the same time in real world contexts. It usually focuses on developing and testing instructional activities and curriculum materials, while investigating how they can best support student learning” (p. 12).⁷ The PSEP/RPP certainly fits the definition of Design Research, which is not surprising since the Collaboratory was conceptualized as a large, multi-site demonstration of Design-Based Implementation Research, and a co-author of the white paper is also a PI of the Collaboratory. It is also not surprising that the PSEP/RPP is carefully designed and highly functional—given that a prior partnership involving many of the same players is cited as an example in the white paper.

The details of the case once again stand as enactments of key features of a Design Research partnership: It is “place-based” (p. 8) in the two districts that are partners, with small but important variations, such as working with elementary grades in one district and middle grades in the other, and with teachers who are volunteers in one district and mandated in the other. Its focus is “on informing practice and research” (p. 8), aiming to promote specific curriculum and practice changes in classrooms, and produce STEM teaching tools and other transportable research-based knowledge for educational improvement.

The partnership “emphasizes co-design” (p. 10), described by Coburn as a “highly facilitated process that engages people with diverse expertise (e.g., research, curriculum, professional development, teaching) in designing, developing, and testing innovations.” A UW researcher described this phenomenon well as working together “without asking anybody to be something they are not.

⁷ The other two are 1) “Research Alliances,” where independent research groups study questions of importance to the district and funnel findings back to the district. Research alliances do not involve the collaborative design/implementation component. And 2) “Networked Improvement Communities,” which are larger networks of districts engaged in rapid cycles of testing to identify solutions to problems in multiple contexts.

Everybody gets to fill in where they see they can.” Examples of co-design include the curriculum adaptations, the professional development meetings, and the STEM teaching tools.⁸ All have “lead” developers but the design and construction process involves substantive input and reflection from multiple perspectives. The PSEP/RPP also has district leaders and researchers “collaborate at every stage in the process” (p.14), from the direction of the partnership to the micro-level work in individual classrooms.

Challenges to research-practice partnerships

The Coburn paper also lists a number of challenges to partnerships. Here there are both lessons to be learned from the Washington case, as well as questions to be raised.

With respect to **bridging the different cultural worlds of researchers and practitioners**, the Coburn paper emphasizes the dichotomy of roles and institutional norms, pointing out that these differences can thwart partnerships. A critical mass of the PSEP/RPP partners benefited from having pre-established trust and “dual citizenship” in both worlds, and beyond that they could use ambassadorship as a bridge for new partners. In particular, the dual citizenship aspect made it quite easy for the researchers and practitioners to initially find common ground. It is important to recall, however, that the researchers’ “theoretical worldview” about the value of collaboration for “understanding” stands as the deepest foundation. This partnership was never tested by the entry of an academic with an opposing “worldview.” Even so, the university partners remain hyper-vigilant to “go the extra mile” and not “foul up” the relationship. One researcher explained:

Even though we have particular mindsets that contribute to this kind of work, we still are working against historical traditions of research in schools. There are some practitioners who are still wary of researchers, understandably so.

Similarly, the researchers and the Seattle district partner worked tirelessly on “**developing and maintaining trust**,” another challenge. They did this through structuring conversations to include all needs and perspectives and continuing to keep trust as a focus, never taking it for granted. These same communication practices and actions also helped in the challenge of “**maintaining mutualism**” or what we refer to informally as “win-win.” For example, changes in the professional development arose not from the researchers defining what the teachers should learn but rather from listening to the teachers describe challenges they faced. Also, the researchers’ social network analyses benefited the district while helping researchers generate new research questions, one of which may lead to a dissertation. This example of the social network analysis and use of classroom observations to re-design PD also immediately speaks to the challenge of “**meeting district timelines while maintaining depth and quality of research**.” Some findings immediately translate into action for the district, while simultaneously feeding into a longer-term research and development agenda at the university.

The prospect that a dissertation could arise out of the “deep dive” work also helps us see how a partnership can address the challenge of “**aligning partnership work with academic norms and**

⁸ A member of the UW team made this comment on this section of the draft: “While many of the STEM teaching tools [STTs] are designed to address problems of practice that come up through PSEP, I don’t think we can say that they are an example of co-design in the way that we co-design PD and curriculum adaptations. The STT’s are still very researcher-driven. The problems addressed are certainly from the partnership, but not the actual design and writing of the tools (except in a very small number of exceptions).”

incentives.” However, it is important to note that the dissertation will be developed within a university sub-culture that places value on the “theoretical worldview” that collaboration produces better understanding. Here, the academics may stand opposite not practitioners but other academics.

The case raises significant questions with respect to the challenge of “balancing local relevance with scalability.” While our discussion focuses on the key design features and qualities of the partnership, it is not able to address the longer-term question of the extent to which the partnership will yield products or capital that will effectively extend the benefits beyond the existing partners. The UW team is generating a collection of STEM teaching tools whose use, value, and impact may well travel beyond the two districts (and may be yielding additional resources). However, the primary ways in which the partnership currently leverages research for school improvement is through the direct involvement of the researchers in the project. That is, research knowledge enters into and informs the improvement work directly by way of the researchers’ growing involvement as professional development designers, as professional development leaders, as curriculum adaptation supporters, as classroom implementation supporters, and as reflective partners for the practitioners. Thus, the researchers themselves are direct “carriers” of in-depth research-based knowledge into the improvement project. It is this direct interaction among researchers and practitioners that creates opportunities for cultural exchange; this no doubt intensifies the leveraging of research for improvement in these districts, but it cannot speak to the question of leveraging RPP-generated research for impact beyond that scale.

Thus, there are some big questions: Will the STEM teaching tools turn out to be products that leverage research for education improvement in districts where researchers do not design and lead professional development? What will be the difference in implementation where researchers take “deep dives” with teachers into the processes of implementation in classrooms and classrooms where teachers have different (or no other) forms of support? What is the potential to scale up the leveraging of research for practice from a model where so much of the research knowledge was made accessible (in the PD and in a small number of classrooms) directly through personal researcher participation?

In this adaptation site, the few teachers who worked with researchers in their classrooms clearly benefited the most. The teachers who simply participated in the professional development meetings did not receive customized access to research-based resources, nor observers’ field notes to provide a window onto the students, nor the opportunity to reflect on a lesson with a skilled observer. From what teachers told us about the practice briefs, they served very little use within PSEP beyond sitting as an optional handout on the back table. One teacher commented that they may be useful to colleagues not involved in the workshops—and that would be a good question for the Washington team to explore. Then there is the question of potential value to others outside the districts. It will take additional study to ascertain whether and how the partnership leverages research for improvement beyond the small “deep dives” group and, further, beyond the bounds of the partnership.

Partnerships are also commonly tested by “challenging school and district contexts” such as turnover and lack of capacity. In the PSEP/RPP, there were two instances of turnover that presented challenges. One involved the loss of the contracted PD leader who was a content expert. It turned out that the

UW team brought on graduate students who had the expertise to step in and fill that gap, enabling the PSEP to hire a project manager, who took the pressure off the administrator. The other involved one district's point person transitioning out of the project. The project weathered both storms. The partnership was not tested, however, by turnover of core leaders, such as the lead partner for Seattle, who is a linchpin of the whole project. His dual citizenship and ambassador capabilities, and his stance as a researcher-seeking practitioner, are vital to the health of the partnership. Similarly, there was not turnover on the UW team that threatened trust and mutuality. Both district partners are very choosy about the individual researchers with whom they partner.

EPILOGUE

Transitions

First and foremost, 2016 at the Washington local lab was a year of leadership transitions: four of the five people in leadership positions moved onto other posts—three leads and one evaluator. Dana Riley Black of ISB decided to go to the Everett School District and Jen Eklund stepped into her role. Dan Gallagher transitioned to a parallel position within the curriculum group at Seattle Public Schools. Mary Margaret Welch stepped in to become the new science program manager for the district and became the new PI of the grant as well. Monica Chandler from the Renton School District moved to a different district, and Christina Bellamy McLean took on her position but with a much broader job description. As a result, Kelly Jones has been leading the work in Renton. The long-term evaluator for the UW team transitioned, and a subset of the team is acting as the evaluator.

In addition to the transitions, there have been ongoing challenges of communication and shared vision across the multiple players in the last year. For example, Renton recently decided to shift to the “observation of evidence of learning” (OEL) model of professional development of the Institute for Systems Biology (ISB). During the district personnel transitions, this shift was not communicated fully to one of the new funders, which required project leads to pause to clarify the objectives of the grant moving forward. The new sponsors are currently reviewing the district's shift in focus.

Also, in the last year Seattle Public Schools has replaced some existing curricula that had been the focus of adaptation work with several units from a different developer because they have a much closer alignment with the NGSS.

Programmatic work

Even though the lab has had to weather significant transitions, transitions to new funders, and communication glitches, the programmatic work has continued to deepen. The work in Seattle has been a little more systematic—in part because of the large number of Seattle teachers involved—75 to 80 versus about 18 in Renton—and also because of the consistent vision.

Focus on English learners: Program work has continued to develop in the areas of ELL support strategies for classroom discourse and developing formative assessments for the curriculum units. The ELL work is being formalized in Seattle by bringing in ELL staff to learn a science-specific version

of what they do more generally. This work is also occurring in Renton, but with the staff from the local lab rather than local ELL staff. The ELL work focuses on using 10 different talk activities created by Kerri Wingert as part of her work with the local lab. Kerri has created a visual map of when to use each of the strategies during the different stages of scientific investigations. This flow chart has been very useful within the Seattle/Renton work but has also been more broadly shared. Kerri's soon to be completed dissertation is based on this work.

Formative assessment development: Formative assessment work has involved teachers crafting “3D” assessments (NGSS three dimensions: disciplinary core ideas, the cross-cutting concepts, and science and engineering practices). The project has developed tools to help teachers focus on the three dimensions when they are writing the assessments. The teachers iteratively test and refine the assessments and study batches of student work together. Recently the project has brought in Jim Minstrell's facet-based analysis as a framework for looking at student work. This comment by a researcher underscores the ways in which this joint work continues to bring the different perspectives of researchers and practitioners together:

We have been bumping into all of those things that you bump into when you try to get teachers out of the mode of scoring student work and more into the mode of analyzing the range of kids' thinking. We are having those discussions and trying to build capacity in that direction and formalize a set of assessments and rubrics that are facet-based.

The local lab is using a self-selected working group of 15 teachers to move the formative assessment work forward. The group meets every six weeks for a few hours to test and refine assessments and rubrics developed in collaboration with the UW team. This approach was used recently to develop facet-based rubrics. Once the working group has helped to refine a tool, it is brought to the remaining teachers.

Equity: A subgroup within the local lab has also been gathered to think about the race and equity issue in science classrooms as part of the race and equity initiative in Seattle.

Fruits of the local lab

A new NSF-funded project, Advancing Coherent and Equitable Systems of Science Education (ACESSE), has grown from the work of the local lab. This project is a collaboration between Phil Bell's team at UW, Bill Penuel's team at UC Boulder, and the Council of State Science Supervisors (CSSS). The project will work to build capacity in areas such as coherence and equity across 13 states, using formative assessment as the lever. According to Bell:

Much of the very specific work that Bill's team has been doing within the Denver Public Schools and that we have been doing with Seattle/Renton is bundling up into this broader project where we are developing resources to use across the country. It is pretty fun.

Part of the idea of ACESSE is to build open education resources that can be broadly disseminated through these state networks. Two professional development modules have been published on the www.STEMteachingtools.org site to date; these are polished versions of work begun in the local lab. Feedback from high-level science education professionals in the Collaboratory was invaluable for refining these pieces and making them more useful.

Together with the Seattle and Bellevue school districts, the local lab has also put in a DRK-12 proposal to extend the work of the local lab to high school science teachers in these districts. Washington's state education office may fund the current project at the middle school level for 6-9 more months.

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