



***Leading from Inside the Classroom:
Three Cases of KSTF Leading Teachers***

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ABOUT KSTF

The Knowles Science Teaching Foundation (KSTF) was established by Janet H. and C. Harry Knowles in 1999 to increase the number of high quality high school science and mathematics teachers and ultimately, improve math and science education in the United States. The KSTF Teaching Fellows Program, the Foundation's signature program, awards five-year Fellowships to promising early-career, secondary science and mathematics teachers, and supports them in their efforts to improve education in their own classrooms and beyond. For more information, visit www.kstf.org.

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ABOUT HORIZON

Horizon Research, Inc. (HRI) is a private research firm located in Chapel Hill, North Carolina specializing in work related to science, technology, engineering, and mathematics (STEM) education. Incorporated in 1987, HRI's expertise encompasses research, evaluation, and technical assistance and information synthesis/dissemination. HRI has provided services for a variety of clients in both the public and private sector, including the National Science Foundation, the U.S. Department of Education, the Carnegie Corporation of New York, numerous colleges and universities, and professional organizations such as the National Science Teachers Association and the National Council of Teachers of Mathematics.

Table of Contents

Introduction.....	1
Methodology.....	1
The Cases.....	3
Heather Haines.....	3
Amanda (Mandi) Kraemer.....	12
Shelley Stanphill.....	20
Cross-Case Findings.....	27
Appendix.....	30

INTRODUCTION

The Knowles Science Teaching Foundation (KSTF) Teaching Fellows Program awards five-year Fellowships to early career science and mathematics teachers, providing them with extensive financial and professional support. Fellows are supported in deepening their STEM content knowledge, utilizing exemplary teaching practices, and situating themselves as leaders in their school communities.

After completing the fifth year of the Fellowship, KSTF provides continued support to Fellows through their Senior Fellows Program. Senior Fellows are encouraged to remain involved with KSTF in a number of ways, including attending KSTF meetings, contributing to the online KSTF community, and participating in national-level KSTF initiatives, such as Project ASCENT and the Engineering Task Force. Further, Senior Fellows are eligible for ongoing monetary support to pursue National Board Certification or activities that impact education beyond their own classrooms.

The overarching goal of KSTF is to create a national network of exemplary “leading teachers” who are equipped to take on leadership roles without leaving their classrooms and students. KSTF adheres to a broad definition of teacher leadership that includes formal (e.g., providing professional development, serving as a department chair) and informal (e.g., collaborative planning, trying new instructional practices and sharing results with colleagues) components. KSTF recognizes that teachers can lead in a multitude of ways, and strives to support Fellows so that they can have far-reaching impacts in diverse school contexts.

KSTF contracted with Horizon Research, Inc. (HRI) to conduct three case studies of KSTF Fellows to help understand the nature and impacts of Fellows’ leadership work, as well as the extent to which participation in KSTF supports their capacity to engage in leadership roles and contributes to their leadership efforts. The case studies were guided by the following questions:

- In what ways are KSTF Fellows exercising teacher leadership?
- In what ways does Fellows’ leadership work involve building collegial relationships and collaborations, and how are those relationships and collaborations developed?
- What are the broader impacts of Fellows’ leadership work?
- How does the Fellows’ leadership work reflect and/or build on their KSTF experience?

METHODOLOGY

To address these questions, HRI, in collaboration with KSTF, first identified a diverse set of case study participants. Selection criteria included subjects taught, school context, what was already known about the types of leadership activities each was involved in, and extent to which individuals have remained involved with KSTF. Using these criteria, Heather Haines, Amanda (Mandi) Kraemer, and Shelley Stanphill were invited, and agreed, to participate in the study. Heather has taught for six years, the past five as a chemistry teacher at Community Charter School of Cambridge (CCSC), a public charter school in Cambridge, Massachusetts. Mandi is in her fifth year as a mathematics teacher at Freedom High School, a large public high school in Orlando, Florida. Shelley has five years of experience teaching physics at Orange County School of the Arts (OCSA), a public charter school in Santa Ana, California that prepares students for higher education and professions in the arts. Both Mandi and Shelley have spent their entire teaching careers at their current schools.

HRI reviewed artifacts of these Fellows’ work, including their application packets for the KSTF Fellowship, yearly portfolios, and summaries of professional development sessions attended. The documents were coded for common themes that served as the basis for questions on interview protocols. Interviews were conducted with Fellows to find out how they are exercising teacher leadership, with particular emphasis on the nature of their leadership activities and the ways these activities reflect and/or build on their KSTF experiences.

After the initial interview, an HRI researcher spent a day shadowing each Fellow at her school on a day she was carrying out a formal leadership activity (e.g., leading a professional development session, facilitating a department meeting). Throughout the visit, the researcher asked questions of the Fellow to elicit her thinking about the design and features of the leadership activity and provide further clarification regarding what was observed. These conversations also served to further illuminate the Fellow's leadership style and goals for leadership.

While visiting each Fellow, the researcher also conducted a focus group interview with the Fellow's school colleagues, composed primarily of teachers in the Fellow's department. The focus group interview covered topics such as the nature of interviewees' collaboration with the Fellow, their perceptions of the efficacy of the Fellow's leadership work, and receptivity to the Fellow's leadership work.

After the school visit, HRI conducted a telephone interview with the Fellow's school administrator focused on his impressions of the nature and impacts of Fellow's leadership work at the school and, when applicable, district level.¹ HRI also conducted phone interviews with additional teachers at the school and with other KSTF Fellows to learn more about extant collegial relationships and collaborations. In addition, HRI conducted phone interviews with KSTF staff members (e.g., Program Officers, Program Directors) in order to better understand the ways that the Teaching Fellows and Senior Fellows Programs supported the Fellow's leadership efforts. All interviews were audiotaped and transcribed, and interview data pertaining to each Fellow were then coded for common themes.

HRI also administered an online social network survey to all teachers in each Fellow's department.² The survey gathered information about the extent of departmental collaboration and centrality of the Fellow to this collaboration. Social network analysis was performed using NodeXL. All study instruments are included in the Appendix.

The resulting cases provide illustrative examples of leadership activities KSTF Fellows are immersed in and the impacts of these activities. Heather, Mandi, and Shelley personify KSTF's ideas about leading teachers as they consistently strive to improve their teaching practice while also supporting others and effecting change on a larger scale. Due to the long list of accomplishments each of these leading teachers has amassed, the cases can highlight only a portion of the ways each has been successful. However, the cases clearly demonstrate the ways in which skilled teachers, when provided with appropriate support, can impact STEM teaching and learning from inside the classroom. A cross-case analysis is also provided to highlight commonalities across the Fellows' leadership experiences.

¹The administrator at Orange County School of the Arts could not be reached for an interview.

²The survey was completed by 4 of 4 science teachers at Community Charter School of Cambridge (100%), 17 of 23 mathematics teachers at Freedom High School (74%), and 8 of 12 science teachers at Orange County School of the Arts (67%).

THE CASES

Heather Haines

To me, [teacher leadership] means leading while staying in the classroom. And I think that's really, really hard to do, because there's a lot of places that just don't offer that kind of flexibility. Maintaining a presence in the classroom so that you don't really forget what that job is and don't have to leave the job that you love while still getting to support other teachers and make change on a bigger level with adults—that's meaningful teacher leadership for me.

Heather weaves her way down the crowded hallway of Community Charter School of Cambridge (CCSC) with a sense of purpose, touching base with several students along the way:

Maria,³ don't forget to stop by and talk to me about making up your test.

Jamal, your shirt needs to be tucked in.

How are you feeling, Tyrone? I'm glad you're back.

As an AP chemistry teacher, Department Chair, and Department Evaluator, there is no time to waste and never a shortage of things that need to get done. Yet, Heather successfully balances classroom teaching and her various leadership roles, adhering to the philosophy that to lead well, teachers “need to have at least one foot in the classroom.”

Heather's interest in education and love of science go back to her days as a student at Illinois Mathematics and Science Academy, a magnet high school:

It totally changed my world and made me think about education really differently because it was so student driven and independent. I loved the experience and really loved science.

Heather eventually became a chemistry major at Wellesley College, where she immersed herself in a variety of research experiences. However, she realized that research just was not fulfilling to her. Rather than discovering an area she was passionate about pursuing, she found herself frequently counting down the minutes until she could leave. That was when Heather made the decision to become a teacher.

Heather's choice of profession was not initially supported by others. Faculty in the chemistry department, advisors in the college career office, and members of her family discouraged her from pursuing a teaching career, suggesting that it would be a waste of her chemistry degree. But during Heather's senior year of college, she received an email describing the KSTF Teaching Fellows Program. The program appealed to her because it provided a way to combine her love of science with her desire to teach. She applied and was accepted into the Teaching Fellows Program in the spring of 2008. Heather credits her acceptance into the Program as a turning point in her trajectory towards becoming a teacher, as it provided the sense of purpose and professionalism that she had been missing:

³Student names are pseudonyms.

KSTF was actually what really helped me feel like this was a valid career choice. In KSTF there were so many examples of incredibly smart people who were making a huge difference in their communities without pursuing bench research. Getting that Fellowship changed my ability to talk about who I was and be proud of the fact that I was a teacher.

Heather earned an M.Ed. degree from Boston College concurrent with her first year of the Fellowship. Then, during her second year of the Fellowship, she moved to Washington, D.C., and helped start The School for Ethics and Global Leadership (SEGL)—a residential school for high school juniors focused on ethical thinking skills, leadership development, and international affairs. Although Heather enjoyed the challenges and responsibilities associated with starting a new school, she was left with little time to teach or engage in opportunities to hone her teaching skills. So in 2010, Heather left SEGL and accepted a teaching position at CCSC.

Leading by Doing

CCSC, a public charter school in Cambridge, Massachusetts, serves a population of approximately 360 students in grades 6–12. The school holds its students to very high standards for both academics and behavior, with the goal of placing all students on the pathway to college success. Heather quickly acclimated to the CCSC school structure and began taking on an array of leadership roles. These roles typically involved working to improve students' learning experiences in her own courses, and then sharing her successes with other faculty in her department.

Heather's early leadership at CCSC took the form of curriculum design and instructional reform efforts, many of which were directly influenced by her participation in the Teaching Fellows Program. For example, KSTF provided funding for Heather to attend a *Physics by Inquiry* workshop at the University of Washington, an experience that led her to reconceptualize and redesign how physics was taught at her school:

I totally rewrote our school's physics curriculum based on their ideas of how important student talk is, like students thinking about what other kids are saying and how to either support it, correct it, verify that it's right, and then using that in class work all the time. Having kids really drive the instruction and having them make meaning out of experiences, and having them coming up with operational definitions struck a chord with me.

KSTF was actually what really helped me feel like this was a valid career choice...Getting that Fellowship changed my ability to talk about who I was and be proud of the fact that I was a teacher.

The Teaching Fellows Program also introduced Heather to a number of research-based instructional strategies, such as Process Oriented Guided Inquiry Learning (POGIL),⁴ a learning cycle of exploration, concept invention, and application. This student-centered approach aims to simultaneously teach content and key process skills by engaging students as members of small, interactive groups. Heather not only integrated POGIL into her own teaching, but took it back to others in her department:

⁴See: <https://pogil.org/>

I use [POGIL] daily in my AP chemistry class, and I've brought it to our chem class and also our bio class. So all those teachers now use POGIL, and it's like big—I'd say a big component of our high school curriculum.

In addition, Heather had the opportunity to explore the use of formative assessment practices through the Teaching Fellows Program, and she set a goal of "focusing on the process of learning rather than the quantitative outcomes of that learning." To this end, Heather attended multiple professional development sessions on formative assessment, embracing Page Keeley's probes for uncovering student ideas.⁵

So I went to a couple of [Page Keeley's] sessions at NSTA to listen to her thought processes and data collection processes and how she uses research to help guide those probes, and then I brought that back to my department here. So I think every course [at CCSC] incorporates some of these formative assessment probes.

In an effort to provide her students with access to upper-level science courses, Heather also proposed, designed, and implemented the first-ever AP chemistry course at CCSC:

When I first came here, the first 9th grader that I remember meeting couldn't pronounce the word "decimal" because he had just never—he didn't have the reading fluency to get there. So to run an AP chem program, to build that from the ground up here, and to have enough kids want to take it that we had to run two sections when our graduating classes are about 55 kids each, makes me really proud. It makes me really proud that our kids want a challenge. It makes me proud that I've inspired kids to want to love science. And it makes me proud that we have done enough work as a whole school community to give kids the math skills and the reading skills and the scientific reasoning skills to be able to handle a course like that...The fact that they come back to me when they get to college and they're like, "Ms. Haines, thank you so much for making me take this really hard course because I had to struggle, and I learned a lot about what it looks like when I struggle and how I can get help, and it's actually helping me a lot now in college." That means so much to me. I'm really proud of that.

Heather's leadership in these areas have not gone unnoticed by others in her school. Katie Riser, Dean of Curriculum and Program at CCSC, described Heather's classroom practices as exploratory and authentic:

She's always experimenting with new stuff. It seems like she always has a new idea about something or has tried something out in her own class or is seeking the bigger picture in what she'd like to bring to teachers...She likes to let students dive in and solve problems for themselves. She's exploratory. She's more likely to set something on fire at the front of the room and then ask questions about it, rather than introducing concepts initially. In her class, she promotes collaboration, and...she doesn't script the collaboration...It feels very authentic.

Likewise, Head of School, Caleb Hurst-Hiller, indicated that Heather makes thoughtful instructional decisions:

She is not afraid to kind of dramatically change up the way she approaches her classes and instruction...she's constantly changing up her curricula, but not in a way that feels like she's just kind of throwing something at a board and hoping the good things stick. They're really,

⁵See for example: Keeley, P., Eberle, F., & Farrin, L. (2005) *Uncovering Student Ideas in Science: 25 Formative Assessment Probes*. NSTA Press.

really well thought through. They're really, really strategic. And she uses data as often and as effectively as any teacher I know. She has her own systems for tracking exit tickets, and classroom participation, and the flow of discussions, and how students are doing on major and minor assignments. She's strategically re-teaching. She's doing everything that we want teachers around here to be doing, and doing that on a daily basis.

These contributions to science curriculum and instruction demonstrated Heather's capacity for leadership, making her well positioned to take on more formal leadership opportunities as they arose.

Leading by Collaborating

Three years into her teaching career at CCSC, Heather was asked to become the science Department Chair:

I think I got the job because I had shown a lot of interest in leadership. Like, whenever there was a committee...I always volunteered for committees. And my school knew about KSTF; they knew I had some training. In department meetings, the fact that I was always going off to PD and coming back with ideas to share and present made it seem like—well, I guess people valued that.

The Department Chair position brought with it a new set of challenges and responsibilities, including facilitating department meetings, leading professional development, scheduling courses, and determining student science placements. Heather credits KSTF with preparing her for this role:

Now as a Department Chair, I totally fall back on everything I learned in KSTF. If I didn't have them, I really don't know how I would lead a department or how I would help other people grow as science teachers. Because I feel like most of the things that I know about teaching and teaching science came from stuff I did with KSTF...I mean, the way that I plan meetings, the way that I interact with teachers, it's all based on what I've seen and done in KSTF. The research that I bring in, the articles that I bring in, the people that I talk about, the work that I bring to the table, it all comes from stuff that I've done with KSTF.

As the Department Chair, Heather devotes a great deal of time and effort to building relationships with members of her department, creating a supportive culture in which other teachers are not afraid to seek her out for help. As two CCSC science teachers explained:

You can definitely go and talk to her about teaching or various things, and get feedback on that. I think she's always very willing to donate her time.

I think that on a day-to-day basis, she's a leader because she's a really good mix of "very awesome" and "put together." She always has agendas for our science meetings and plans everything else in advance. And she gets everything done, but she also will always have a minute to spare if you have a question for her.

A social network questionnaire focused on the relationships among CCSC science teachers further highlights Heather's central position in the department. When asked who they go to as a resource for their professional growth and development, every science teacher in the department indicated relying on Heather to a great extent (see CCSC Science Department Sociogram).

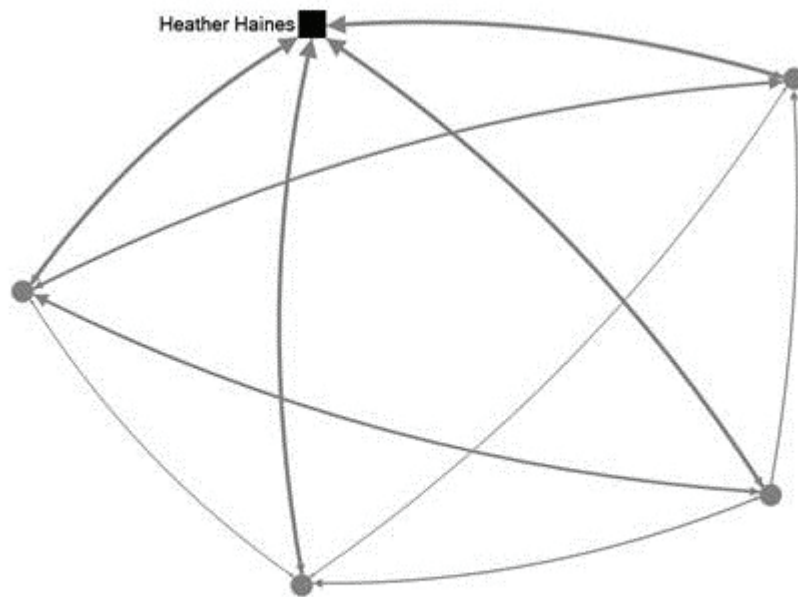
Heather has also been working to broaden this culture in the department so that the science teachers can rely on each other for professional growth and development. The CCSC Head of School described Heather's efforts in this area:

She does a really nice job, particularly this year, of building team cohesion, building a sense of community within the department. Focusing on some of the softer leadership skills that end up paying dividends later on. So, making sure that people in the department like each other, and spend time with each other, and support each other, and look at each other's work. That has been the tenor of the department this year, and I think it has been really healthy and really fantastic.

Now as a Department Chair, I totally fall back on everything I learned in KSTF. If I didn't have them, I really don't know how I would lead a department or how I would help other people grow as science teachers.

Heather's success in fostering these professional relationships is also apparent in data from the social network questionnaire. Nearly all teachers in the department reported relying on every other teacher for their professional growth and development, indicating a high degree of collegiality and cohesiveness.

CCSC Science Department Sociogram



A sociogram is a graphic representation of social links within a group. The nodes represent teachers and arrows represent collaborations among teachers; the thicker the line, the more extensive the collaboration. The size of an arrowhead indicates the extent to which a teacher relies on the other as a resource for professional growth and development, with a larger arrowhead representing more reliance.

Leading by Creating a Culture of Continuous Improvement

Heather believes that teachers can lead in multiple ways, but that they can have the biggest impacts by “working with individual teachers in mentoring and coaching roles, and changing their classroom practices and the way they think about teaching science, and helping them grow to become the professional that they want to be.” Seeing both a need and an opportunity, Heather advocated for putting teacher performance evaluation responsibilities into the hands of teachers, and in 2014, CCSC made this school-wide organizational shift. The CCSC Head of School explained how Heather, as an established leading teacher, was prepared to step into an evaluation position:

This year we moved to a different model. We expanded the number of people that are formally evaluating faculty to ensure that there was a one-to-one model, meaning that there is one evaluator for each teacher. Not that there are 30 evaluators; people take on multiple evaluatees. But there's one person who is observing your teaching. There's one person who is reviewing your curriculum materials. And so the feedback that you're getting is much more aligned. And Heather played a critical role in pushing me as the Head of School to think about, consider, weigh, and ultimately implement that organizational shift. This was not a place, historically, where Department Chairs were doing that kind of work, which we really considered to be the work of administrators. This is the first year that we've done it, and it's been great...she's doing all the things that evaluators here do, and doing them really, really well.

I believe the best leaders are thinking deeply about classroom practice all the time, and it's hard to do if you don't have a classroom to think about.

As the newly appointed science Department Evaluator, Heather's overarching focus is on supporting teachers, using the evaluation system as a means of helping teachers grow as teaching professionals. This support manifests itself in many ways, including instructional support, logistical support, and emotional support. For example, one science teacher mentioned Heather's efforts in helping her acclimate to a new school environment:

[Heather's] been really instrumental in helping me keep my teacher personality while helping me reinvent myself as a CCSC teacher...And I didn't feel like it was my evaluator. It was more like welcoming and a chance to let me see that out of the 14,000 things that are different here, let's just focus on these first few and then add on. It was more of a gradual adjustment, and that was really helpful.

Another science teacher described Heather's instructional guidance:

I feel like when we have our official evaluation meetings, there's certain boxes that you have to check, where she's taking notes during her observation of me and she says, "This was good, this you should change." But it always ends up going above and beyond that, because it will lead to some conversation about, like, what is the purpose of labs anyway, or what resources she has that she wants to share with me. She's always really excited to talk more about teaching or teaching science.

Unlike earlier school leadership opportunities that she had been presented with, and turned down, during her time at CCSC, the Department Evaluator position was attractive to Heather because it allowed her to retain some teaching responsibilities, specifically AP Chemistry:

I love that work and can't imagine leaving it. But also because I believe the best leaders are thinking deeply about classroom practice all the time, and it's hard to do if you don't have a classroom to think about.

This unwavering commitment to teaching has served her well as an evaluator, earning her a level of respect and credibility from the teachers she evaluates. As one CCSC science teacher said:

She still fought to hang on to some science teaching, which I think is really admirable because I think that it's—sometimes I think when you move to an admin role, you quickly forget really the intricacies of everyday teaching and it kind of becomes easy to glorify your teacher days. But she's definitely still in the trenches with us, reinventing the wheel at times to get kids to learn things. I think that's a really big thing that I appreciate about Heather, is that she's still doing the teaching aspect. And I think that, at least for me, for an evaluator, that earns a lot of respect.

Leading by Learning

Upon completing the Teaching Fellows Program, Heather promptly looked for ways to stay involved with KSTF. Even with countless teaching and leadership responsibilities at CCSC, Heather became actively involved as a member of the KSTF Senior Fellows Program. She consistently demonstrates a willingness to take risks and make her teaching public in order to improve her own instructional practices and advance the teaching profession as a whole.

Heather volunteered to join the planning team for KSTF's Achieving STEM Course Effectiveness through Networked Teachers (ASCENT) project. The project aims to create teams of teachers at various locations across the country to work on problems of practice in STEM education. KSTF will support these teacher-led teams in applying an improvement science model,⁶ testing out changes in their own contexts and then sharing their learning across the network so that teachers can collaboratively develop solutions. KSTF believes that the principles and practices of improvement science, particularly when carried out by teachers, has tremendous potential to help bridge the gap between research and practice in education.

In order to think deeply about how they might apply improvement science principles to solving STEM education problem, the team decided to conduct a pilot study focused on improving instruction in advanced high school STEM courses, specifically by supporting students' literacy skills. Heather volunteered her AP Chemistry classes for the pilot study, and began scaffolding her students' reading and writing skills by using discussions, writing prompts, and examples. Heather also collected student data, which she shared with the other members of the team, to look for evidence of improvement. Dina Portnoy, Director of Senior Fellows Programs at KSTF, described Heather's willingness to immerse herself in this work:

We thought it would be a good idea if we did a pilot project, and she jumped right in and said, "You can use my classroom." Again, I think that she was willing to make herself vulnerable. At the same time, I think she did that because she thought, "Oh, this will help me as a teacher and it will help my kids."...Every week she gives her kids an assignment, she sends us their work, we score it, we meet every week for half an hour to talk about it. Somebody came and observed her. We've interviewed her kids. She wrote about it...I think the willingness to learn new things and collaborate with other people, if that's not a teacher leader, I don't know what is.

⁶See: <http://www.carnegiefoundation.org/our-ideas/>

KSTF Program Officer for Teacher Development, Roseanne Rostock, also described Heather's contribution to the work of the team:

She's the one on the ground, and she's really driven so much of how we understand the problem, how we understand the week-to-week fluctuation that's happening...She's just been such a massive lead in this whole effort. If we didn't have her in the classroom, and also designing the prompts every week and giving them out, and being so efficient at getting the data, then I don't know that we would have learned this much...And she's so committed to it... she's like, "I see change, and I know that kids are able to do things at this point this year that last year they weren't able to do. I just know that's happening." And this has really excited her in her classroom teaching. It's one of those things that renews you as a teacher.

At the same time, Heather volunteered to join the KSTF Engineering Task Force, a group dedicated to supporting teachers in integrating engineering into all science courses. Although her background was in chemistry, Heather viewed the Engineering Task Force as an opportunity to deepen her content knowledge in the area of engineering and gain ideas about how to incorporate engineering into her curriculum:

I knew that engineering was something that I should be teaching, but had no idea how to do it. I had zero training in engineering, and as a chemistry teacher, it feels really outside my wheelhouse. And, the curriculum that I've seen for chemistry in general doesn't really ever include engineering, but that's really big in NGSS. So I joined [the Engineering Task Force] and started figuring out, with the help of other Senior Fellows, what engineering means and what it looks like in my classroom.

To further their work, the Engineering Task Force decided to have a teacher carry out an engineering project, sharing the process and student outcomes with the group. Heather was first in line to volunteer. The Director of Senior Fellows Programs at KSTF highlighted Heather's willingness to take this risk:

She had never done anything like this before. She put herself out there. Shared her student work. Her successes as well as her failures. That—even among teachers in KSTF who are natural born leaders, who are very accomplished—that can be a little scary...But she was ready to put herself out there and share what she had done because, not only did she want to help the group out, but I think she thought she would learn something. And she did.

Heather's work with the Engineering Task Force greatly influenced her thinking about what it means to teach engineering concepts, and she was able to draw on these new understandings when working with other teachers at her school:

When my department set goals at the beginning of the year, one of the ones they set, without me saying anything, was "We want to learn what engineering is." And so I knew so much more because I had been part of this task force in KSTF, and felt really comfortable sharing my work and what I had learned. But also really comfortable just giving them opportunities to try things, and experiences, and support so that they felt like they could do the same sort of exploration I had done to come to their own conclusions...[KSTF gave me] the sense of respect for teachers and their professional judgment. And belief that they can grow in their classroom practice by exploring and feeling supported and like a professional.

Summary

Heather eagerly looks for opportunities to be a leading teacher. Some of her leadership is by example, as she seeks out opportunities to improve her teaching and make her practice public. Other aspects of her leadership are more formal, as she has become the chair and evaluator of the science department at her school. Heather willingly takes on new roles, both in her school and as a KSTF Senior Fellow. These leadership efforts are readily recognized by her administrators, teaching peers, and KSTF colleagues.

Heather attributes much of her success as a leading teacher to her participation in the KSTF Teaching Fellows and Senior Fellows Programs. The programs provided Heather with funding for professional development, introduced her to best practices in science education, and encouraged to share her knowledge with others. Perhaps most importantly, KSTF brought Heather into a network of like-minded educators to support her ongoing improvement efforts:

I didn't really understand how important all the other pieces were until I really got into the Fellowship. Like, I didn't realize that the community in KSTF is really what makes it amazing. The ideas that people pass around and who you get to work with. That, to me, is what makes it really special.

Yet, as the Director of Senior Fellows Programs explained, Heather's success can be attributed to a combination of KSTF and her inherent leadership qualities:

If there was no KSTF, Heather would still be awesome. But I think that a lot of [Heather's willingness to try new things] takes place within a certain context. Not only in her school, but within this network of teachers and this experience of KSTF.

In effect, KSTF has catalyzed Heather's leadership, providing opportunities for her to bring about changes in her local context, and allowing her to explore avenues for advancing the teaching profession more broadly. KSTF nurtures and supports Heather's leadership, allowing her to do more than she otherwise might have done on her own.

Amanda (Mandi) Kraemer

I think a lot of times when people think about leadership within education, they think of teachers not being teachers anymore—becoming full-time instructional coaches and then becoming administrators, or moving downtown and being part of the school board office, or things like that. I think that's what I used to think of and I didn't want that for myself. I wanted to stay in the classroom. I've always thought that that's where I belong. And so, through the work with KSTF, I really started to see the importance of leadership on the ground and leadership that teachers are doing while still staying in the classroom.

Mandi is involved in every aspect of the mathematics department at Freedom High School. She teaches four sections of AP Statistics, two sections of AP Calculus, and organizes the student mathematics honor society. She also serves as the department chair, leads professional development, and runs school and district-wide Professional Learning Communities (PLCs). But despite her never-ending to-do list, Mandi always makes time for people. From her students, to other teachers, to the custodial staff, she knows the names and stories of those she encounters on a daily basis. She has a knack for listening to people and making each one feel special and important.

I really do place a lot of importance in developing relationships with people. So I'm close with our front desk admin. We talk about her grandbaby. And the woman who does copies—I go and check in with her, and we chat about how her son is doing with his classes. And then the teachers in my department...they are people that I work with closely, but they are also friends of mine and we know each other on a personal as well as a professional level...In my time here, I've managed to get close with people in my department and other teachers outside my department, which I think is valuable too. I'm close with quite a few English teachers and social studies teachers...It's the same with students too. If you know what's going on with their lives, and they know that you care about them as a person, they're going to be more willing to come back and work hard for you.

This genuine interest in meeting people and developing relationships was an important factor in her pathway to becoming a teacher. After obtaining a bachelor's degree in physics and a minor in mathematics from the University of Florida, Mandi chose to spend a year volunteering overseas, immersing herself in unfamiliar cultures and interacting with diverse groups of people.

So I spent time in Southeast Asia and in a few different parts of Africa over the course of a year, spending three or four months here, a couple months there. And what they ended up having me do in most of those places was stuff that was education-related, either working with teachers or teaching directly or things of that nature. [It was] probably because I had no real skills otherwise, like building or anything like that. So they were like, "Hey, have her teach." But I really enjoyed it. Teaching had always somewhat been in the back of my mind. I have several teachers in my family. I tutored a lot throughout high school and college, and I enjoyed doing that. But this kind of reinforced a few things for me. It reinforced that I did enjoy teaching, it reinforced that I had some level of aptitude for it, and it also showed me that teaching is really, really hard. And that, if that was something I decided I wanted to pursue, that I needed to actually receive some instruction in how to do it.

Mandi then returned to University of Florida, forgoing physics in favor of a master's program in mathematics education. It was during this time that she learned about the KSTF Fellowship Program.

I received an email from one of my professors in grad school about this opportunity. And you know, you get those emails all the time, but this one kind of caught my eye. The description about the Fellowship Program philosophy and goals and things like that really struck

a chord with me, because it's all about supporting teachers at the beginning of their careers. It's a really difficult career to begin with. The retention rate is horrible in the first five years. I also really liked what they said about their ideas about student-centered learning and a discovery approach in the classroom. Just everything that was in that email really, really spoke to me. And then I went on the website and kind of dug a little deeper and saw what the Fellowship itself entails, with all the professional development and collaboration with other beginning teachers around the country. And so I felt like it had my name on it, so I went ahead and applied.

Mandi became a KSTF Teaching Fellow during the spring of 2009. Later that spring, she went on to earn her master's degree and then took a position as a mathematics instructor at Freedom High School, a large public high school in Orlando, Florida. Freedom High School appealed to Mandi because "it's larger, it's more diverse, and there are a lot of different opportunities."

Leading by Learning and Sharing

All students at Freedom High School who are interested in taking advanced placement (AP) courses are allowed to do so, regardless of their prior mathematics grades. As a result, Mandi was tasked with teaching AP Statistics and AP Calculus courses comprised of students with varying mathematical backgrounds. She quickly began to explore means of differentiating her instruction in order to meet the needs of her students.

My AP Statistics classes in particular are really, really diverse in terms of a lot of things, but really in terms of mathematical exposure...So that's what piqued my interest in really trying to take a look at what differentiated instruction can look like in a classroom...I felt like a lot of times in my classroom with the AP stats kids I was teaching to the middle and wasn't really reaching anybody in the process. I mean, I was doing fine. It wasn't terrible. But I felt like I had kids who were very much not being pushed, and I felt like I had kids who felt like they were drowning. There maybe were a few kids in the middle that I was appropriately reaching, but it felt like the vast majority weren't being met where they were.

Basically, the big thing that KSTF did for me, now that I think about it this way, is just kind of removed the barriers. The things that often get in the way of trying something new, KSTF will find a way to make it happen for you.

When Mandi's assistant principal approached her about flipping her classroom as part of a pilot project, she jumped at the chance to learn more about using the strategy as a means of differentiating her instruction.

So I think what really spoke to me when I first read about it was the idea that sometimes direct teaching is inevitable. There are certain topics that that's just going to be the most efficient way to communicate that information. And you can use flipped instruction to move that direct instruction to a time and space where students are able to access it on their own and then use class time in a more constructive manner...so by moving that instruction to the home, we can then use class space to do something maybe more hands on or more discovery oriented, or even just to practice problems...that kind of philosophy really spoke to me because I felt like there were days where class time wasn't used as productively as I would have liked.

Jeanne Vissa, Program Officer for Teacher Development (TD) at KSTF, also described Mandi's motivation for flipping her classroom and highlighted how her use of this strategy evolved over time.

Somewhere along the way she found that she was doing so much teaching of content that she felt there was inadequate time for investigation in the classroom...that is when she got involved in flipped teaching, because she wanted to create more space in the classroom for students to engage in authentic problem-solving...Her first year that she [flipped her classroom] the students had access to viewing [the videos.] In the second year that she did it, after being more engaged in formative assessment, she and I looked at how she...could she make those videos more interactive, where students might make notations of "I found this really challenging" or "A follow-up question I have is this"...Therefore, she could look at which concepts she had to review for the entire class, which she might review in stations, how she might use students who perhaps had no difficulties to amplify her teaching. So I gave her all kinds of strategies to think about, using flipped teaching as an extension of the classroom where she would be asking questions.

KSTF supported Mandi's efforts to flip her classroom, paying for her to attend a relevant professional development session in San Francisco and providing her with a tablet and software to aid her in making videos for her students. Mandi also drew on the experience of KSTF TDs to help her reflect on her efforts. She credits the program with removing potential obstacles on her pathway to success.

I think the big role the KSTF played was that I knew that I would have the support I needed to make it happen. I knew that I wouldn't fail when trying [a flipped classroom] out because of a lack of support... [The TDs] in KSTF are always so willing to sit and listen and push your thinking and help you reflect. I knew that if I were struggling I would be able to get help from somebody who would very much want me to succeed and be invested in my success. So I had not only the human support piece, but I also knew that KSTF would send me to a workshop or help provide me with the materials. Basically, the big thing that KSTF did for me, now that I think about it this way, is just kind of removed the barriers. The things that often get in the way of trying something new, KSTF will find a way to make it happen for you.

In addition to developing her skill with this strategy, Mandi shared what she had learned about flipping her classroom with other teachers at her school, teachers in her district, and her KSTF colleagues.

After [the flipped classroom session in San Francisco], I got back and I shared all that I had learned with the other teachers that were piloting this flipped teaching program...and then at [KSTF] summer meeting another Fellow and I did a poster session about flipped teaching and shared our experiences...There's also a collaborative group within my district of AP statistics teachers, and I've been sharing my videos with a lot of them lately. And so I think it's moving towards not only benefitting my students, but also benefitting other teachers too.

This principle represents a core element of Mandi's beliefs about being a leader—it is not enough to simply change her own practice, but rather it is important to share her experiences with others.

I think teacher leadership is teachers being introspective about their own practice, finding something that they think is significant and worth sharing, and finding a way to share it. Maybe that's on a small scale, maybe it's on a bigger scale, but I think the sharing piece is what differentiates teacher leadership from just good teaching.

Leading by Building Learning Communities

During Mandi's second year at Freedom, her assistant principal asked her to lead a PLC for pre-calculus and AP Calculus teachers, her first formal leadership role. As a new PLC leader, she

facilitated monthly meetings, keeping to a set agenda and monitoring group discussions to ensure that everyone was heard.

[Facilitating the PLC] was my gateway to leadership in a formal sense at my school...That was the first vertically aligned PLC at my school, and I really saw a lot of potential in that and thought it was really, really important...It wasn't a super hands-on role, but it definitely built some confidence in me because I was in that group with some teachers with obviously more experience than me. And they were really receptive to me as a facilitator...So the fact that they were supportive and my assistant principal gave me that opportunity was a really, really great first step.

As time progressed, Mandi's responsibilities as a PLC facilitator changed. When PLCs were being reorganized due to teacher turnover and course enrollment, Mandi convinced her administration to create a new PLC specifically for her and the other AP Statistics teacher in her school. This very small PLC afforded her the opportunity to think deeply about how to teach statistics, and also provided her with the opportunity to mentor a new teacher.

This year I would say the goal is...how can we ensure that students are learning statistics in a deep and thorough and meaningful way. Sometimes that means planning lessons together or making common assessments or looking at data and saying "Well, my kids did poorly on this question and your kids did well on it. How did you explain this particular aspect in a way that made sense to them?" And sometimes it's utilitarian. This is her first year teaching this stuff and it's me, saying, "Okay, this is how I taught it. If you're comfortable we could keep it the same way. If you have ideas, we can incorporate those..." I try really hard to, as much as I can, get her ideas. I try to reassure her that I think she has unique and important things to bring to the table.

In addition, Mandi was asked to lead a newly created, district-wide PLC focused on AP Statistics. In this role she was given the flexibility to plan and run meetings as she saw fit, choosing activities and topics of discussion in an effort to raise the level of teaching across the district.

[The district] created a few content-specific PLCs surrounding some of the AP courses that the district has been less successful in, and AP Statistics was one of those that they identified. And so the Advanced Studies Coordinator for the district asked if I would lead that up. So for the past two years, we've met 3 to 5 times each year...We all met at a central location within the district and did some collaborative planning, shared some ideas and lessons, and stuff like that. We talked about what was challenging and brainstormed ideas to remediate that. And it's been a pretty cool opportunity to facilitate that, because what's new and different about that for me is that it's not a school scale, it's on a district-wide scale.

As a PLC leader, Mandi helps other teachers reflect on problems of practice and prompts them to collaborate with one another to find solutions. This facilitation style was greatly influenced by her participation in KSTF.

But sometimes, if we are talking about a bigger issue, the reason it's an issue is because there is not an easy answer. There's value in asking questions and probing and talking about an issue, and really trying to get everything out in the light. That, I think, is what it means to facilitate or lead from a facilitation perspective. You are not supposed to be the one who has the answers. You are the one that's helping someone pick apart their thinking. And I definitely don't think I would have had that perspective, had I not experienced KSTF.

Something that just developed in me over the five years of the Fellowship was the importance of asking questions more than giving answers. I think that really, really influenced the way that I approached PLC work before, and how I'm trying hard to approach it now. Sometimes it's okay to just have an answer, and there's the answer, and move on, and that's it. But sometimes, if we are talking about a bigger issue, the reason it's an issue is because there is not an easy answer. There's value in asking questions and probing and talking about an issue, and really trying to get everything out in the light. That, I think, is what it means to facilitate or lead from a facilitation perspective. You are not supposed to be the one who has the answers. You are the one that's helping someone pick apart their thinking. And I definitely don't think I would have had that perspective, had I not experienced KSTF. Because it's easier to have the answers, but it's definitely more meaningful to take the long way.

Leading through Support and Empowerment

In 2014, Mandi was asked to take on even greater leadership responsibilities as the mathematics Department Chair.

So I think because of the times I had already had a little bit of a leadership role, the assistant principal that oversaw our department approached me and asked if [being the department chair] was something that I was interested in doing. I had some questions for him about what the expectations were and things like that. It was tough. There were some big shoes to fill...So I was intimidated to go into that role, but I accepted.

As the Department Chair, Mandi serves as a liaison between mathematics teachers and school administration, communicating information and expectations. In addition, she plans and facilitates monthly department meetings. In the past, these meetings were generally used to deliver logistical information. However, Freedom recently began devoting department meeting time for professional development. Rolando Bailey, principal of Freedom High School, described this new professional development model and Mandi's role in it:

We tasked our department chairs to select individuals within their own departments, so when they have department meetings they can carry out those professional developments based on their strengths. Ms. Kraemer has already led two of those professional developments. One where teachers felt like they needed a little bit more support in teaching statistics. Well, she provided that professional development in terms of how to effectively teach statistics to their kids...Because obviously, when peers are standing in front of their peers preparing to teach, that is an awkward situation. But she broke the ice and made sure that she led the first PD, and that gives other teachers confidence to say "I can lead it as well."

Mandi credits KSTF with substantially influencing her thinking about how to get the most out of this department meeting time:

I can think of one specific activity we went through in Year Five. We were all given these scenario case study things to read about how a meeting was organized in a school... We all read through these and discussed as a whole—their merits, the potential things that could be improved, things like that. I think, in doing so, we all brought our own personal experiences to the table. And it really opened my eyes because, I think, before then all I thought of when I thought of a faculty meeting or department meeting was the going through the list of bullet points that could have just as easily been emailed out and that's it. It just wasn't even on my radar that it could be more than that. I think that activity, which happened early in the year, really just opened my eyes. It sounds silly, but it just showed me the possibility of what could be done with that time. Because time is so precious and we really have very little time together to collaborate.

Informally, Mandi also spends a great deal of time as the Department Chair checking in with teachers, gauging how they are doing in their classrooms and serving as a resource to them for both content and pedagogy. In the words of three Freedom mathematics teachers:

One of the lessons that I had to teach was polar functions...I didn't remember anything about it. So I asked her and she took the time, took 20 minutes and was like, "This is the way that I teach it. This is what I need them to remember." And she kind of went through a mini lesson with me. And then I took it and I adapted it and used it in my teaching. I definitely feel like you can go to her about anything, regardless of your subject, and she does not mind teaching you... It's really nice that she's totally open to teaching to a teacher to help you teach your students. So that's a ripple effect. I can go to her for anything.

In my first year teaching, I just would always have questions in the middle of class. Like literally between classes. It's fifth [period] and I didn't know the answer to a question. Now it's about to be sixth [period] and I need the answer. And I could just pop over there and she would quickly teach me or explain to me why something is the way it is.

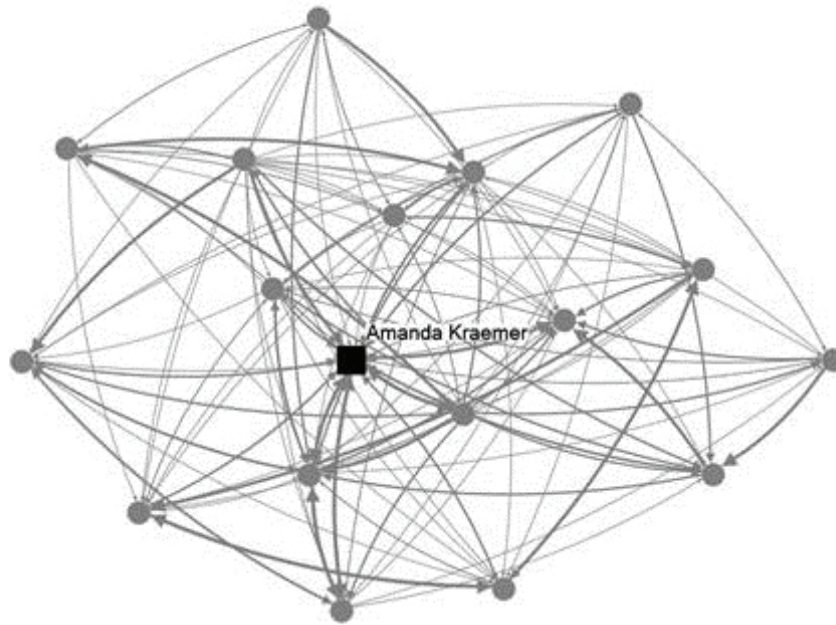
She goes out of her way to help people get to "Freedom level." And if they're not at Freedom level, she will tell them, "Hey, these are the things you need to work on." Stuff like that... She wants to keep that level of rigor...We are number one in the county right now, and if it wasn't for her, her expectations of us, we wouldn't be able to get kids to that expectation.

However, very early on, Mandi realized that she did not want to be the only one that teachers in the mathematics department relied on. She wanted teachers to collaborate with one another and be resourceful in coming up with solutions to problems. Roseanne Rostock, another KSTF TD, described Mandi's efforts in distributing leadership across her department:

She found that in the past, whoever had had the position of department head had been the problem solver for the department. And what had been set up was a dynamic that whenever there was an issue they went to the department head and said "fix this" and then somebody worked on fixing it. And Mandi was like, "I don't want to play that role. I don't think that's the role I should be playing. I think if there's an issue, then we should together try to figure out how to fix it." And so she really tried to explore this question throughout the year of "How can I distribute leadership so that people don't think I'm the problem fixer and people feel more empowered to address problems as they come up together?"... So I think her leadership style is really thinking about, "How do I help others empower themselves so that together we are a strong community, instead of us being a community with one person leading everything."

A social network questionnaire focused on the relationships among Freedom's mathematics teachers suggests that Mandi has been successful in distributing leadership. When asked who they go to as a resource for their professional growth and development, every responding mathematics teacher in the department indicated relying on Mandi to some extent (see Freedom High School Mathematics Department Sociogram). However, teachers also indicated relying on one another, with several other teachers in the department playing key roles. These data indicate that while Mandi is a leading teacher in her department, she is not the only one that teachers can rely on for support.

Freedom High School Mathematics Department Sociogram



A sociogram is a graphic representation of social links within a group. The nodes represent teachers and arrows represent collaborations among teachers; the thicker the line, the more extensive the collaboration. The size of an arrowhead indicates the extent to which a teacher relies on the other as a resource for professional growth and development, with a larger arrowhead representing more reliance.

Leading by Caring for Others

A key component of Mandi's leadership involves fostering relationships with others, both on a personal and a professional level. Some of these relationships are with members of the mathematics department. As two mathematics teachers said:

When Mandi became the head of the department, she always valued my opinion and made it very clear that she valued my opinion...My first couple years were very, very rough, and she was someone who kind of helped turn it around for me and made me see, "You do have a stake in the school and your opinion does matter, and you are a big part of the math department."... And that made me work way harder than I had even been working before. It's like, well, you don't want to let someone down.

I think she creates a sense of community around everyone she touches. She comes in contact with you and she makes you feel like you are part of the team...I remember homecoming week was the first week after I started teaching, and I got a phone call from Mandi and she's like, "Hey we're going to the homecoming parade. [The mathematics honor society] is marching, you should come walk with us." And I'm like, "Okay." So I remember I got to ride in the back of the truck, and here we are in the homecoming parade. And I'm like, "That's the best thing ever." And ever since then, it's like, "Yeah, I actually matter." She's able to make everyone feel like they matter.

Perhaps most importantly, these caring relationships extend to her students. Despite her many roles and responsibilities, Mandi strives to always put her students first.

I think the biggest [challenge I've faced as a leading teacher] is doing the extras. Doing the leadership stuff and not having to sacrifice the education that my own students get. I want to always make sure that my students are coming first and that they don't get slighted.

Rolando Bailey shared an example of Mandi's willingness to make herself available in order to help her students be successful:

We give a mock AP assessment on a Saturday. The students are here on a Saturday, and she has a 100 percent attendance rate of students coming in on a Saturday taking a four-hour mock exam that will mirror the AP exam they are going to take in May. And then, just to give you [an idea of the] caliber teacher that she is, before they actually take the exam, she takes her own personal money to take them to the mall, to like the food court, and they actually have a crash study session. She feeds them out of her own personal pocket to assure the students that they are going to be successful.

In this way, Mandi serves as a role model for other teachers at her school, demonstrating the value of investing in students so that they are willing to work hard and invest in themselves. Her fellow mathematics teachers not only recognize, but admire the relationships she has formed with students over the years. In the words of two:

Her caring spreads and you see it all the time just in the way she interacts with the custodial staff or the administration or the kids. I'll be in there and the kids will walk in and kind of interrupt a conversation she and I are having, but she is like all ears if they need to talk to her... She really does care and she's good at showing that she cares.

Kids find her approachable. They know she's the adult, and they know she's the teacher, but never a friend. Which is really, really hard. I know that she has influenced a lot of kids' lives. I know that a lot of kids have picked certain career paths or choices because of her. Kids come back and come to see her and talk to her. I've been in her room before and I see kids that I was like, "Didn't they graduate years ago? Two or three years ago?" coming back and wanting to help out... That means you left a very big footprint in that kid's life, and I feel like as a teacher, that's what we work for. It's not only to teach them the material, but also, when they think back, you want to be someone that was a positive role model for them. I've seen her be that for kids.

Summary

Mandi personifies a collaborative approach to mathematics education. She does not teach in isolation. She does not problem-solve in isolation. She does not lead in isolation. Rather, she recognizes that people can accomplish more when they work together. Mandi has formed relationships with numerous individuals at Freedom High School, which have contributed to improved mathematics teaching and learning. But perhaps most importantly, she clearly prioritizes her students, giving her knowledge, time, money, or just a listening ear to help them be successful.

Mandi attributes many aspects of her leadership style to her participation in the KSTF Teaching Fellows Program. The program provided her with the support and resources to be successful as she took on new leadership endeavors, eliminating many barriers along the way. The Teaching Fellows Program also helped Mandi to craft her style of leadership, distributing it to others in her department, allowing her to have far-reaching impacts on her school community.

Shelley Stanphill

I've really come to understand that teacher leadership can be a very informal, leading by example sort of experience. That when I am fully invested in my teaching—when I am trying a new thing out, when I am committed to being the best teacher that I can be, and I'm taking on this inquiry stance and this very professional stance towards my classroom—that other teachers notice that. And that facilitates these really great, quality conversations, and it actually ends up leading change from the ground up in a lot of ways.

Shelley might not be the first person one would think of as a leading teacher. She does not chair multiple committees. She does not push for large, school-wide changes. She does not seek to be the most visible teacher at her school. Nonetheless, Shelley, in her quiet, understated style, has significantly impacted science teaching at Orange County School of the Arts (OCSA). Through her persistent efforts to improve her own teaching and unwavering commitment to supporting others, she has helped to redefine and reshape science instruction one classroom at a time.

Shelley did not always want to be a teacher. As an undergraduate physics major at Harvey Mudd College, she initially planned to pursue a Ph.D. and a career in research. But following her sophomore year of college, she interned at the Breakthrough Collaborative, a nationwide organization that aims to pave the path to four-year colleges for underserved students; increase the quality, quantity and diversity of the teaching pipeline; and develop career educators as instructional leaders. Shelley taught a six-week biology unit to a small class of seventh graders, an experience that ultimately shaped her career path.

I still remember, it was the second day of class. I was trying to teach the students about the scientific method and research design and things like that, and I had mapped it all out in my mind. I was going to ask this question, and they're going to answer with this. And so I had this whole line of questioning and answering already planned out. And in my first class, with the very first question, they answered in a way that was totally unexpected to me. And I kind of went, "Oh, that's not your part in the script."...And it was interesting, because as we were talking and as things were unfolding, I was finding that they were taking the lesson in these totally new directions that I had never anticipated...And I just remember thinking, "Oh my gosh, this did not go at all the way I wanted it to. How do I change this?"...It was the most invigorated I had ever felt from a challenge like that... Every challenge that came up from teaching, I found interesting. And I said, "I really want to understand how do I respond to that, and what are the students thinking, and how do we take the lesson and where the students are, and try to get those things to merge together. It was literally just that second day, I got home at the end of the day and I was exhausted, but I said, "This is absolutely what I want to do for the rest of my life." I'd just never been so excited about things going wrong before.

During her senior year at Harvey Mudd, Shelley applied and was accepted into the KSTF Teaching Fellows Program. The program provided her with an opportunity to "reaffirm the value of teaching and the value of my education towards teaching." Equally important, the program immersed her in a community of like-minded individuals:

It was very important that I find other people who, similarly, were very serious about their education, who were passionate about science, but who also thought that teaching was absolutely a completely worthwhile and valuable way to use their science education...To me, the important thing was having access to a community of people who were all passionate about teaching, who had interesting ideas, who wanted to shake things up, who were really

thoughtful about their practice and didn't just go through the motions. I think I was really hoping to find people who would challenge me and who would push me to be the best teacher that I could be.

Leading by Example

During her first two years of the Fellowship, Shelley attended UC Berkeley full time, earning both a master's degree and a teaching credential. However, these were challenging years for her as a KSTF fellow because she was not yet teaching in a classroom. Consequently, she did not feel like she was in a position to contribute to the community that she immensely valued.

I started off really feeling under-qualified to be there. I didn't really have an outlet to try these things. I didn't feel like I had as much to contribute...I felt like I was getting so much out of it and I wasn't really sure what I was giving back to the community.

Things changed during her third year of the Fellowship when Shelley accepted a position as a science teacher at Orange County School of the Arts (OCSA), a grades 7–12 public charter school focused on preparing students for higher education and professions in the arts. At OCSA, Shelley was finally able to try out many of the ideas and strategies that were introduced to her in the program. She eagerly jumped in, employing several strategies all at the same time, including standards-based grading, backwards planning, and a flipped classroom. She also embraced project-based learning (PBL), bringing real-world problems and challenges into her physics instruction. KSTF Program Officer for Teacher Development, Roseanne Rostock, described her observations of Shelley's efforts in this area.

To me, the most important thing was having access to a community of people who were all passionate about teaching, who had interesting ideas, who wanted to shake things up, who were really thoughtful about their practice and didn't just go through the motions.

It was the first year that she was really trying to integrate these project-based units into her teaching...she was really restructuring all of the concepts she was trying to teach around a project. Also trying to provide enough scaffolding for the students so that they would work effectively in groups, that they would have access to the content when they needed it, that they would be able to put these ideas together in some kind of a solution to a problem they were addressing. Considering it was her first year working at it, she was doing very well and she was asking great questions.

As Shelley experimented with her physics curriculum and teaching, she continued to rely on the KSTF community for guidance and support. This collaboration with members of the KSTF community pushed her to think deeply about her practice and gave her the confidence to take instructional risks.

The way that the Fellowship has most impacted my teaching is the fact that I am in a community where it is okay and encouraged to take risks...It really helped me, I think, to feel like I'm free to try those things out. And it's okay to be vulnerable and to bring some of those failures to the Fellowship and say, "Oh my gosh, this totally flopped. How did you approach this when you tried it out?" I think again, the biggest element of the Fellowship that has changed my teaching is just having that really supportive community. A community that will affirm my professionalism, even if I do things and try things that don't work out very well the first time.

Although Shelley was initially focused only on her own teaching practice, other science teachers at OCSA started to take notice, to ask questions, and to examine their own teaching practices. Through her focus on personal improvement, Shelley started to effect wider change. As teachers became interested in changing their science teaching, they turned to Shelley for help and advice. In the words of two OCSA science teachers:

[Her instructional practice] is innovative, and she's willing to take risks. I think the students know that it's different and talk about it, and there is an energy that's created there, I think, that other people hear about...She challenges others to look at their instructional practices and be willing to take risks and try different things.

I think she makes you examine your teaching and what you're doing. Like, "Oh, wow, Shelley's trying this!"

Sally Lopez, OCSA Learning Specialist, also explained how Shelley's commitment to her own practice positioned her as a leader among her peers.

Her actions speak louder than her words...but it's in what she's doing and people seeing and hearing what she's doing that, it kind of makes people question what they're doing. Like, she switched to the flipped classroom for a while and was making videos and using those. The kids were watching those at home and then using class time for practice and activities and those kinds of things. Which was kind of revolutionary, at least on our campus. And then also with the PBL. Her curriculum is the majority PBL in both of the classes she teaches, and one of the other physics teachers has jumped on board with that and really questioned his instructional style and found ways to embed the PBL.

Leading by Collaborating

During Shelley's third year at OCSA she was asked to take on the role of Department Facilitator, and charged by her principal with "coordinating and directing the professional growth of that particular department." However, she struggled to define what leadership looked like in this new role.

At our school we really have this precedent set where we are very clearly facilitators, we're not chairs. There's not supposed to be this big power difference between the facilitator and the non-facilitator. And then when I took over the facilitator position...I felt like I was sort of torn between, "well, there's this expectation that the facilitator is not really a significant leadership role, but I'm being asked to do these very significant things in terms of coordinating and organizing all this professional development."

Therefore, Shelley once again turned to KSTF for guidance.

I think the most obvious way that [the Fellowship Program] affected [my role as department chair] is just by having other people at other schools that I can talk to and get some ideas from in terms of what does a Department Facilitator or department chair look like at your school, and how do you interact with your fellow teachers, and how do you balance this leadership role with also maintaining, obviously, a peer relationship with these colleagues.

Shelley credits KSTF with shaping her thinking about the type of Department Facilitator she wanted to be, helping her understand that "even though I am taking on a stronger leadership role, that doesn't have to look a particular way...it doesn't have to look like this very formal power-based kind of position." Rather than use the Department Facilitator role primarily as a means to guide teachers towards some predetermined set of goals or endpoints, Shelley chooses to lead by listening.

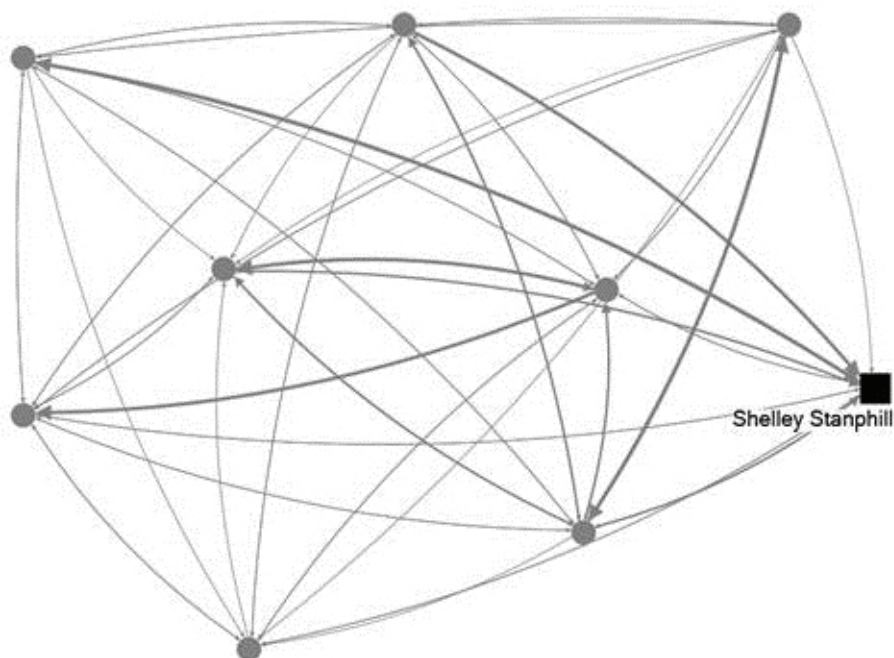
She facilitates monthly department meetings, focusing on topics that are of interest to teachers, including literacy integration and questioning techniques. However, she is most comfortable working with teachers one-on-one or in small collaborative groups, focusing on improvement in aspects of science instruction identified by the teachers themselves. Two science teachers described their interactions with Shelley:

She makes it easy for you to go to her with concerns and questions. That's important for a leader, not to be too harsh and not to worry about going to them for questions in fear of how they would react. She's easy to talk to.

And you always know that she's a resource to go to, to help you when you have questions like that, or to give you new ideas so that you're not going through the same mundane thing...She'll give you innovative ideas to go about [instruction] in a new way.

Shelley also draws upon her wealth of knowledge about education research to support teachers, frequently pointing them to readings about topics of interest. In the words of two science teachers:

OCSA Science Department Sociogram



A sociogram is a graphic representation of social links within a group. The nodes represent teachers and arrows represent collaborations among teachers; the thicker the line, the more extensive the collaboration. The size of an arrowhead indicates the extent to which a teacher relies on the other as a resource for professional growth and development, with a larger arrowhead representing more reliance.

She's really good at identifying exactly what kind of resources I should be looking for, or even knowing off the top of her head different resources that I could use for teaching a certain topic...I had this idea, "Oh, I think it would be really great to teach kids at their own paces." And she's like, "Oh yeah. I know two great books about that. Borrow them from me."

I had asked about mastery learning...and she had resources for me to go through. And I know she's shared those [resources] with other people as well. She has a big library of educational research. She's very helpful with that.

Shelley's collaborative approach as the Department Facilitator is also apparent when examining the network of connections among members of the science department (see OCSA Science Department Sociogram). When asked who they go to as a resource for their professional growth and development, all responding science teachers indicated that they rely on Shelley to some extent. And as might be expected, Shelley indicated that she relies on her colleagues in return. These data reflect Shelley's collaborative style of leadership. Rather than situating herself in a position of authority, Shelley has found a way to lead by example, listening to others and providing support in the moments they most need it.

Leading by Mentoring

During her third year at OCSA, Shelley was also asked to be a mentor in the Beginning Teacher Support and Assessment (BTSA) program, a California-funded program designed to support the professional development of newly credentialed, beginning teachers. Although she was still relatively new to the teaching profession, Shelley's participation in the Teaching Fellows Program gave her the confidence to take on this new role.

[The Engineering Task Force has] given me some expertise to talk about this thing that seems very scary to a lot of people in my department right now.

I tend not to volunteer. Even though I'm feeling more empowered by KSTF, I still, overall, kind of feel like "Oh, I don't want to jump up and impose or anything like that."...But at the end of my second year [of teaching] they were looking for new BTSA mentors and our BTSA coordinator pulled me aside and said "I really want you to apply for this position." And I said, "Ok, if you think that I'm ready. I've only been teaching for two years. I don't know if I have the expertise that's needed." Then, of course, I remembered all my lessons from KSTF and the fact that a lot of [mentoring] is a matter of being a thoughtful listener and questioner to further push back on and expand on other teachers' thinking. So I said, "Okay. Well sure. I can try that out." So I applied and I was invited on.

As a BTSA mentor, Shelley works one-on-one with teachers across subject areas, helping her mentees set goals, suggesting means for meeting these goals, and helping them reflect on their practice. This cycle of professional growth and reflection came easily to Shelley, as she had already participated in this process for many years as a KSTF Teaching Fellow.

I feel really lucky because KSTF taught me a lot about what it means to be an effective collaborator and how to have those quality inquiry-based professional discussions. So even though a lot of other people kind of look at the BTSA requirements and they're like, "Why are they asking us to do this?" or "What's the point of this?" or "We have to reflect again?" or whatever, it was always easy for me because I had already been a part of those sort of conversations for years prior.

Shelley's thoughtfulness and effectiveness as a mentor is readily apparent to others in her school. Sally Lopez, coordinator of the BTSA program at OCSA, described what makes Shelley such an asset as a mentor.

I think really, with Shelley, she asks good questions. So those questions, not being judgmental at all, just encourage deeper thinking. I think that's definitely one of her strengths. I think another strength...is she has a wealth of knowledge and resources...Her mentee came to her

saying "Hey, this is what I want to do," and Shelley had two or three books on it, had articles to provide, so she's just super resourceful. And a lot of things she's tried in her own classroom, which makes her so credible.

Leading by an Ongoing Commitment to Improvement

Upon completing the Teaching Fellows Program, Shelley sought out opportunities to continue to grow as a professional. It was at this time that the KSTF Engineering Task Force was starting. The task force is aimed at supporting teachers in integrating engineering into all science courses, a pursuit that captured Shelley's attention.

I realized I don't know anything about engineering and this is a direction that we are really trying to go in, and so I should really be more well versed in what engineering is and is not, and be preparing my students for pursuing careers in engineering, or at least adopting an engineering mindset.

The task force is working on producing various outputs, including curriculum design and project models, professional development materials, and classroom research. Dina Portnoy, Director of Senior Fellows Programs at KSTF, described Shelley's involvement in this work:

Shelley has been a very important, methodical person in the Engineering Task Force. She hasn't tried to get on the leadership team. She hasn't done presentations. But every piece that she is involved in...she's incredibly thoughtful about. The Engineering Task Force has developed a number of rubrics, including...this all-encompassing rubric that tries to identify and define every bit of work that students might do in an engineering project, as well as alignment to the NGSS standards. Shelley was very important in terms of kind of seeing that process all the way through. Helping to develop it, going back over it and looking carefully at it, and identifying what was useful about it, what might not be as useful, what further research people needed to do, ways they could use it and test it out. And she went back into her classroom to use a lot of these things and came back to the following meetings with insights based on what she had done. To me, that's a leadership quality.

Scott Murphy, another member of the task force, also described Shelley's contribution to the work of the team:

I think her [biggest contribution is her] willingness to try things in her own classroom and her willingness to take risks. I know that the projects we were looking at were not always something she was familiar with...One of the projects that we were working on came from [the Patterns Approach to Physics⁷], so we were piloting that in her classroom and videotaping it for us to use on the website, which was very helpful...There's a lot of "type A" personalities in KSTF who are very eager to put their own two cents in. And Shelley is really good at recognizing that and allowing everybody to say their piece and then reflecting on it and helping everyone understand how what they want fits within a larger picture. Really holding the group together. She's like the group glue that keeps everyone from becoming unhinged.

However, while Shelley has been important in thinking about how to support teachers more broadly, she has primarily used her participation in the task force as a way to improve her own teaching.

⁷See: Hill, Bradford. (2013). The Patterns Approach. *The Science Teacher*. 80(3).

Participating in the Engineering Task Force has really helped me to understand that engineering is so much more than just building something. That there is a whole thematic process that goes into engineering where you are doing research and you are generating different alternatives for design and optimization. I think that's the biggest piece of it, this idea that engineering consists of taking an idea, testing it out, gathering data, and then making it better...[I just] implemented my first full four-phase engineering design project...It's a wind turbine project where students try to design an optimized wind turbine that will maximize work output by changing different parameters of the blades that are used on it...And it's cool to see the quality of the discussions that the students have had. Where they are really making data-driven decisions and looking at the data and thinking about, "Well, what are the implications of this? What are the realities of the situation? How do you measure? How do you quantify that trade-off?"

Additionally, participation in the task force has equipped Shelley with the knowledge, skills, and confidence to begin the conversation about engineering integration at OCSA.

This issue of implementing more engineering in the classroom has just recently come to the attention of a lot of math and science teachers. And so it's a very salient topic and something that I would guess a lot of teachers feel ill equipped for. And so by having this space where I've been able to really dedicate some time and energy to thinking about what it means to implement engineering design, and to get to work with other teachers who are all in various stages of implementing engineering into the classroom, it's kind of positioned me to be in a place where I can talk to my curriculum team about engineering and share examples of what I've been doing and get them connected to other people who are implementing engineering design in various contexts. It has given me some expertise to talk about this thing that seems very scary to a lot of people in my department right now.

Summary

Shelley is an excellent example of a teacher leading by example. She takes risks and strives to improve her own teaching practices, which, in turn, inspires others to do the same. Shelley also uses her deep knowledge and expansive resources to support others in their science instruction, embracing opportunities to work with teachers in small groups or one-on-one. These interactions allow her to help others reflect on their teaching practice, resulting in improved science instruction at OCSA.

KSTF has been instrumental in shaping Shelley's conception of leadership and providing opportunities for her to become the kind of leader she wants to be. During her time in the Fellowship Program, Shelley relied on the KSTF community for support. Now as a Senior Fellow, she continues to find value in that community, drawing on her experiences in the Engineering Task Force to both change her own instruction and provide support to teachers in her school and more broadly.

KSTF gave Shelley the confidence to take on leadership roles she may not have otherwise tried, such as serving as a Department Facilitator and BTSA mentor. But more importantly, KSTF cultivated the leadership skills that she already had, including an aptitude for deep reflection on science curriculum and the ability to effectively mentor teachers one-on-one. Rather than pushing her to become a particular type of leader, KSTF has encouraged Shelley to draw on her strengths in order to effect change.

CROSS-CASE FINDINGS

Heather, Mandi, and Shelley are examples of accomplished leading teachers who have made significant contributions to the teaching profession, honing their own instructional practices and providing support to other teachers in order to improve the quality of STEM teaching more broadly. Although their styles are unique, there are commonalities in the nature of their work as leading teachers. Looking across the three cases, themes emerged regarding the ways in which the Fellows exercise leadership, build collegial relationships, and impact the profession beyond their school contexts. Further, their leadership work draws heavily from their experiences in the KSTF Teaching Fellows and Senior Fellows Programs. These themes are discussed below in the context of the questions that guided the study.

IN WHAT WAYS ARE KSTF FELLOWS EXERCISING TEACHER LEADERSHIP?

The Fellows serve as leading teachers in various ways. They have all taken on formal leadership roles (e.g., Department Chair/Facilitator, Department Evaluator, school/district PLC leader, PD provider) and have used these roles to foster productive conversations around STEM content and pedagogical strategies. In some cases the Fellows were recruited for these roles and, in other cases, they actively pursued them. However, it is evident that all three have embraced formal opportunities to serve as leading teachers when these opportunities were presented, and have had success in this capacity.

Leveraging these formal roles, the Fellows have pushed for changes in their schools, bringing new ideas and perspectives on improving STEM teaching to their school administration. Because of their work, many of these approaches have been adopted school wide. For example, Heather was instrumental in shifting teacher performance evaluation responsibilities into the hands of teachers at her school. Similarly, Mandi advocated for the creation of a PLC specifically for AP Statistics teachers. It appears that the Fellows' voices are well respected by school administration, as well as other leading teachers, and they often serve as "leaders of leaders" within their schools.

The Fellows also serve as leaders in informal ways, primarily by example. Each demonstrates a commitment to continuously bettering her own practice, incorporating innovative teaching strategies to improve student learning. For example, the Fellows have experimented with flipped classrooms, problem-based learning, formative assessment, and standards-based grading. They actively seek out new ideas and strategies in order to continue to refine their teaching.

In addition, the Fellows welcome opportunities to provide informal instructional support to their colleagues, and are frequently approached by others in their departments with questions. For example, when teachers come to Shelley with problems, she is able to provide them with readings and resources that introduce them to new ways of thinking about teaching. Similarly, Heather volunteers to collaboratively plan lessons with struggling teachers, pushing their thinking about intended outcomes and the value of different classroom strategies for meeting those outcomes.

Further, the Fellows demonstrate for their peers caring ways of interacting with students. This care is noticeably manifested in their deep commitment to improving STEM learning for all students. But beyond that, the Fellows also invest in their students and come to know them as individuals. For example, Mandi goes out of her way to learn about her students' lives outside of the mathematics classroom, resulting in students who remember her and come back to her classroom to visit year after year. In these ways, the Fellows serve as role models to other teachers, highlighting the value of building relationships toward increased student engagement, effort, and achievement.

IN WHAT WAYS DOES FELLOWS' LEADERSHIP WORK INVOLVE BUILDING COLLEGIAL RELATIONSHIPS AND COLLABORATIONS, AND HOW ARE THOSE RELATIONSHIPS AND COLLABORATIONS DEVELOPED?

It is clear that the Fellows believe in the power of collaboration, and have taken steps to enable others to be both learners and leaders. The Fellows frequently help other teachers improve their teaching practices, but are equally eager to learn from teachers who are successfully implementing innovative approaches. Their willingness to take instructional risks and openness about their successes and failures are recognized by their peers. The Fellows inspire and encourage other teachers to also take risks in the service of student learning, providing support and encouragement should they falter, and praise when they succeed.

The Fellows also work to broaden the culture of collaboration in their departments by distributing leadership. For example, Shelley devotes department meeting time to professional topics identified by the teachers themselves, providing opportunities for them to discuss problems and potential solutions in order to raise the overall level of teaching in the department. Mandi encourages teachers in her department to go to one another when they have questions or problems, rather than positioning herself as the one with all of the answers. The collaborative environments that Fellows have fostered are evident when examining departmental sociograms, from which it is clear that not only do the Fellows play a central role in their departments, but that teachers also rely on each other for their professional growth and development.

WHAT ARE THE BROADER IMPACTS OF FELLOWS' LEADERSHIP WORK?

Although the Fellows have effected change in their schools, they have also made differences more broadly. At a district level, Mandi leads a PLC for AP Statistics teachers, sharing her ideas and strategies related to mathematics teaching with a larger audience and impacting education for numerous students. Fellows have also contributed to a broader conversation of issues related to policy and practice, adding their expertise to groups grappling with these difficult issues. For example, Heather and Shelley have been active participants in the KSTF Engineering Task Force, and Heather has served as a member of the planning team for Project ASCENT. In these groups, they have been prompted to think deeply about education policies and practices, and contribute their knowledge by developing resources, participating in teacher-led improvement communities, and serving as first adopters of education initiatives. As a result, the Fellows have expanded their leadership outward, impacting education beyond their local contexts.

HOW DOES THE FELLOWS' LEADERSHIP WORK REFLECT AND/OR BUILD ON THEIR KSTF EXPERIENCE?

The Fellows have embraced KSTF's model of continuous reflection and self-improvement. All three have demonstrated a commitment to examining their teaching practice and the effects of their practice on students. The Fellows also help other teachers through the process of reflection, asking probing questions in order to stretch teachers' thinking and push them to consider solutions they had never entertained before.

The Fellows immensely value the KSTF community, frequently relying on it for help, advice, and support related to their own teaching. Further, the Fellows have turned to the community for advice about their roles as leaders, seeking out and soliciting advice from TDs and peers when negotiating the tricky balance between being a member of a department and a leader of a department. Additionally, the Fellows have used the KSTF community as a model for interacting with teachers in their local contexts. For example, Shelley and Mandi both attribute the structure and purpose of their department meetings to their experiences in KSTF, crediting KSTF with shaping their thinking about facilitating purposeful, productive meetings.

Teacher leadership is sometimes defined in very narrow terms, with a focus on formal, top-down approaches. But KSTF seeks to expand that definition, helping Fellows see that leadership does not fit neatly into a single box or require a specific skill set. Each case study participant came into the Fellowship Program with an impressive résumé, and over the five-year Fellowship, KSTF nurtured those strengths. As the Fellows became more capable of leading in ways that were best aligned with their skill sets, they gained confidence to step up and lead in new and unfamiliar ways. For example, as they became proficient at sharing ideas and resources with teachers in informal settings, they gained the confidence to provide support more formally. As they became more skilled in their own teaching, they began to evaluate the teaching of others. By providing ongoing financial and professional support to the Fellows, KSTF has helped the Fellows accomplish more, and have greater impacts, than they might have otherwise had on their own.

APPENDIX

INSTRUMENTS

FELLOW INTERVIEW PROTOCOL

1. How did you get into teaching? Why did you want to be a teacher?
 - a. Please describe your current teaching position. [PROBE: subject(s), grade level(s), years' experience]
 - b. Were you in this position when you applied to the KSTF Teaching Fellows Program?
 - i. [If no:] How did you end up in your current position?
2. Why did you apply to be a KSTF Teaching Fellow?
 - a. What did you hope to get out of the Teaching Fellows Program?
 - b. Describe your experience in the Teaching Fellows Program. Was it what you expected? Why or why not?
3. How has the Teaching Fellows Program influenced your teaching?
 - a. What specific aspects of the program have had the greatest influence on your teaching? [PROBE: face-to-face meetings, online community, Program Officer]
4. As you probably know, KSTF is very interested in teachers as leaders. What does teacher leadership mean to you? [PROBE: What does it look like? What are some ways in which teachers can be leaders?]
 - a. How has the Teaching Fellows Program influenced your thinking about teacher leadership?
 - b. How has the Teaching Fellows Program prepared you to be a teacher leader? [PROBE for specific examples]
5. Since completing the Teaching Fellows Program, have you remained involved with KSTF in the Senior Fellows Program? Please describe. [PROBE: Ways involved? How often?]
6. [If involved in the Senior Fellows Program]:
 - a. What aspects of the Senior Fellows Program have had the greatest influence on your teaching? [PROBE for specific examples]
 - b. How has the Senior Fellows Program influenced your thinking about teacher leadership?
 - c. Similarly, what aspects of the Senior Fellows Program have had the greatest influence on your preparedness to be a teacher leader? [PROBE for specific examples]
7. I understand that you have [describe activity].
 - a. How did you become interested/involved in [activity]?
 - b. What are your goals/intended impacts for [activity]?
 - c. How has this activity/your role in this activity evolved over time? [PROBE: How has it grown/expanded? To what extent have other teachers become involved?]
 - d. In what ways did the KSTF Teaching or Senior Fellows Programs influence your experiences in [activity]? [PROBE: Specific things that influenced?]
 - e. Looking back, what do you wish you knew before you did [activity]? Why?
8. Are you currently involved in any additional leadership activities? [PROBE: At your school? At the district level? Outside of your school/district?] Please describe.
 - a. How did you become interested/involved in [activity]?
 - b. What are your goals/intended impacts for [activity]?
 - c. How has this activity/your role in this activity evolved over time? [PROBE: How has it grown/expanded? To what extent have other teachers become involved?]

- d. In what ways did the KSTF Teaching or Senior Fellows Programs influence your experiences in [activity]? [PROBE: Specific things that influenced?]
 - e. Looking back, what do you wish you knew before you did [activity]? Why?
9. Are there any leadership activities that you used to be involved in but are no longer involved in? Please describe.
- a. How did you become interested/involved in [activity]?
 - b. What were your goals/intended impacts for [activity]?
 - c. How did this activity/your role in this activity evolve over time? [PROBE: How did it grow/expand? To what extent did other teachers become involved?]
 - d. In what ways did the KSTF Teaching or Senior Fellows Programs influence your experiences in [activity]? [PROBE: Specific things that influenced?]
 - e. Looking back, what do you wish you knew before you did [activity]? Why?
10. Are there any specific leadership activities that you hope to take on in the future? Please describe. [PROBE for specific activities if only general areas/topics are provided]
- a. What motivates your interest in [activity]?
 - b. What plans do you have for taking on [activity]?
 - c. In what ways did the KSTF Teaching or Senior Fellows Programs influence your desire to take on [activity]? [PROBE: Specific things that influenced?]
 - d. What would enable you to do [activity]?
11. Were there any leadership activities over the past few years that you wish you could have pursued but you didn't?
- a. [If yes] Please describe.
 - b. [If yes] Why weren't you able to pursue [activity]?
12. We've talked about a number of different activities that you've been involved in over the past few years. Which one or two of these are you the most proud of? Why?
13. What aspects of teacher leadership do you feel the most comfortable with?
- a. In what areas of teacher leadership would you like to grow?
14. What barriers or challenges have you faced as a teacher leader?
- a. How have you overcome these challenges?
 - b. What leadership challenges still remain?
15. What do you think sets you apart from other teachers in your school or district?
16. Is there anything else you would like to say about your work as a teacher leader or your experience in the KSTF Teaching or Senior Fellows Programs?

FOCUS GROUP INTERVIEW PROTOCOL

1. If you had only 30 seconds to tell someone about [name] what would you say?
2. How has [name] influenced you? [PROBE: Additional ways?]
3. In addition to the things that have already been mentioned, how has [name] influenced others in your school?
4. How has [name] exhibited leadership in your school? [PROBE: Additional ways?]
5. Of all the things we've talked about, what would you say is [name] greatest contribution to your school? Why?
6. How would this school be different if [name] didn't work here?

ADMINISTRATOR INTERVIEW PROTOCOL

1. How long have you been the [job title] at [school name]?
2. How long have you worked with [name]?
3. How frequently do you interact with her in an average week?
 - a. When you interact with her, what types of things do you discuss/work on together?
 - b. Do your interactions with her most often occur during formal meeting times, or more informally? Please describe.
 - i. What formal opportunities exist for you to interact with [name]?
4. How familiar are you with [name]'s [science/mathematics] teaching?
 - a. How would you characterize her teaching style?
 - i. What are her greatest strengths when it comes to [science/mathematics] teaching?
 - ii. How does her teaching style compare to that of other teachers in her department?
5. What are some ways [name] has exhibited leadership in your school? [PROBE for multiple examples: curriculum design, collaborative planning/teaching, committees, etc.]
 - a. How did she become involved in [this role/this activity]?
 - b. How long has she been [in this role/involved in this activity]?
 - c. What are her major responsibilities [in this role/activity]?
 - d. In this capacity, how has she impacted other teachers?
6. I understand that [name] is currently the [science/mathematics] [department chair/Department Facilitator]. What are her major responsibilities in this role?
 - a. What are her greatest strengths as a [department chair/Department Facilitator]?
7. I understand that [name] has also been involved in [activity].
 - a. What are her major responsibilities in this role?
 - b. What are her greatest strengths in this capacity?
8. Overall, what would you say have been the greatest contributions of her leadership to the science department? In other words, how has she shaped the department? Please describe.
9. More broadly, how has she shaped the school community? Please describe.

KSTF COLLEAGUE INTERVIEW PROTOCOL

1. Are you currently a classroom teacher?
 - a. [If yes]
 - i. Where?
 - ii. How long have you been there?
 - iii. What do you teach?
 - a. [If no]
 - i. What are you doing instead?
 - ii. How long have you been in this position?
2. Describe your professional relationship with [name].
 - a. How long have you known her?
 - b. Were you in the same KSTF cohort?
3. During the Fellowship, what types of things did you work on with [name]? What types of things did you collaborate on? [PROBE: working groups, presentations, papers, etc.]
 - a. How did [the activity] start? Who initiated it? Who planned it?
 - b. What was your role in [the activity]? What was [name]'s role?
 - c. What would you say are the most important things [name] brought to [the activity]? What were her greatest contributions?
 - d. What were the goals for [the activity]? What did you hope to accomplish?
 - e. In general, how did [the activity] go?
 - f. What were the biggest impacts of [the activity] on others?
4. During the Fellowship, I know that [name] was actively involved in [topic]. Did you work with her on this topic? Please describe.
 - a. [If yes]
 - i. How did [the activity] start? Who initiated it? Who planned it?
 - ii. What was your role in [the activity]? What was [name]'s role?
 - iii. What would you say are the most important things [name] brought to [the activity]?
 - iv. What were her greatest contributions?
 - v. What were the goals for [the activity]? What did you hope to accomplish?
 - vi. In general, how did [the activity] go?
 - vii. What were the biggest impacts of [the activity] on others?
5. Have you worked with [name] on anything since completing the Fellowship Program? Perhaps as part of the Senior Fellows Program? Please describe.
 - a. [If yes]
 - i. How did [the activity] start? Who initiated it? Who planned it?
 - ii. What was your role in [the activity]? What was [name]'s role?
 - iii. What would you say are the most important things [name] brought to [the activity]? What were her greatest contributions?
 - iv. What were the goals for [the activity]? What did you hope to accomplish?
 - v. In general, how did [the activity] go?
 - vi. What were the biggest impacts of [the activity] on others?
6. How would you characterize [name]'s leadership style?
 - a. What are her greatest strengths as a leader?
7. What do you think sets [name] apart from other teachers?
8. Is there anything else you would like to say about [name]'s work as a teacher leader or your experience working with her?

SCHOOL COLLEAGUE INTERVIEW PROTOCOL

1. Please describe your current position at [school name].
 - a. What are your major responsibilities in this role?
 - b. How long have you been in this role?
2. How long have you worked with [name]?
3. How frequently do you work with [name] in an average week?
 - a. Do your interactions with her most often occur during formal meeting times, or more informally? Please describe.
 - i. What formal opportunities exist for you to interact with [name]?
4. What types of things have you worked on with [name]?
 - a. How did [the activity] start? Who initiated it? Who planned it?
 - b. What was your role in [the activity]? What was [name]'s role?
 - c. What would you say are the most important things [name] brought to [the activity]? What were her greatest contributions?
 - d. What were the goals for [the activity]? What did you hope to accomplish?
 - e. In general, how did [the activity] go?
 - f. In what way(s) did [the activity] impact her department?
 - g. In what way(s) did [the activity] impact your school more broadly?
5. I understand that you have worked with [name] on [activity]. Please describe.
 - a. How did [the activity] start? Who initiated it? Who planned it?
 - b. What was your role in [the activity]? What was [name]'s role?
 - c. What would you say are the most important things [name] brought to [the activity]? What were her greatest contributions?
 - d. What were the goals for [the activity]? What did you hope to accomplish?
 - e. In general, how did [the activity] go?
 - f. In what way(s) did [the activity] impact her department?
 - g. In what way(s) did [the activity] impact your school more broadly?
6. Are you aware of any other ways that [name] is providing leadership at your school or beyond? Please describe.
 - a. What are the impacts of these leadership activities?
7. Overall, what would you say have been the greatest contributions of her leadership to the [science/mathematics] department? In other works how has she shaped the department? Please describe.
8. More broadly, how has she shaped the school community? Please describe.
9. How would you characterize [name]'s leadership style?
 - a. What are her greatest strengths as a leader?
10. What do you think sets [name] apart from other teachers?
11. Is there anything else you would like to say about [name]'s work as a teacher leader or your experience working with her?

KSTF STAFF MEMBER INTERVIEW PROTOCOL

1. Please describe your current position at KSTF.
 - a. What are your major responsibilities in this role?
 - a. How long have you been in this role?
2. Describe your professional relationship with [name].
 - a. How long have you known/worked with her?
3. During the Fellowship, what types of things did you work on with [name]?
 - a. How did [the activity] start? Who initiated it? Who planned it?
 - b. What was [name]'s role in [the activity]?
 - c. What would you say are the most important things [name] brought to [the activity]? What were her greatest contributions?
 - d. What were [name]'s goals for [the activity]? What did she hope to accomplish?
 - e. In general, how did [the activity] go?
 - f. What were the biggest impacts of [the activity] on others?
4. During the Fellowship, I know that [name] was actively involved in [topic]. Did you work with her on this topic? Please describe.
 - a. [If yes]
 - i. How did [the activity] start? Who initiated it? Who planned it?
 - ii. What was your role in [the activity]? What was [name]'s role?
 - iii. What would you say are the most important things [name] brought to [the activity]? What were her greatest contributions?
 - iv. What were the goals for [the activity]? What did you hope to accomplish?
 - v. In general, how did [the activity] go?
 - vi. What were the biggest impacts of [the activity] on others?
5. Have you worked with [name] on anything since she completed the Fellowship Program? Perhaps as part of the Senior Fellows Program? Please describe.
 - a. [If yes]
 - i. How did [the activity] start? Who initiated it? Who planned it?
 - ii. What was your role in [the activity]? What was [name]'s role?
 - iii. What would you say are the most important things [name] brought to [the activity]? What were her greatest contributions?
 - iv. What were the goals for [the activity]? What did you hope to accomplish?
 - v. In general, how did [the activity] go?
 - vi. What were the biggest impacts of [the activity] on others?
6. How would you characterize [name]'s leadership style?
 - a. What are her greatest strengths as a leader?
7. What do you think sets [name] apart from other teachers?
8. Is there anything else you would like to say about [name]'s work as a teacher leader or your experience working with her?

SOCIAL NETWORK SURVEY (TEACHER VERSION)

1. To what extent do you rely on each of the following individuals as a resource for your professional growth and development as a [science/mathematics] teacher? You will see your own name on the list. Please select "Not at All" for yourself.

	Not at All		Somewhat		To a Great Extent
a. Name 1	0	0	0	0	0
b. Name 2	0	0	0	0	0
c. Name 3	0	0	0	0	0

2. Teachers may rely on many different individuals as resources for their professional growth and development. To what extent do you rely on (1) [Fellow name], (2) people in your school other than [Fellow name] (e.g., other teachers, administrators), and (3) people outside your school (e.g., district personnel, teachers in other schools) in each of the following areas? (5-point extent scale: 1=not at all, 3=somewhat, 5=to a great extent)

	[Fellow Name]	Other people in your school	People outside your school
a. Deepening your content knowledge			
b. Selecting course content and/or materials			
c. Addressing difficulties students may have with particular content ideas			
d. Implementing new teaching methods/strategies			
e. Modifying teaching methods/strategies that are not working as intended			
f. Ideas for increasing student interest/engagement			
g. Formally and/or informally assessing student learning			
h. Classroom management/discipline			
i. Communicating with parents/guardians and/or other community members			
j. Building professional community with other teachers			
k. Keeping informed about current trends and issues in the profession			
l. Understanding educational policy and the implications for teachers and students			

3. In what ways has [Fellow name] been the most influential to your [science/mathematics] instruction this school year? Please explain.

SOCIAL NETWORK SURVEY (FELLOW VERSION)

1. To what extent do you rely on each of the following individuals as a resource for your professional growth and development as a [science/mathematics] teacher?

	Not at All		Somewhat		To a Great Extent
a. Name 1	0	0	0	0	0
b. Name 2	0	0	0	0	0
c. Name 3	0	0	0	0	0

2. Teachers may rely on many different individuals as resources for their professional growth and development. To what extent do you rely on (1) people in your school (e.g., other teachers, administrators), and (2) people outside your school (e.g., district personnel, teachers in other schools) in each of the following areas? (5-point extent scale: 1=not at all, 3=somewhat, 5=to a great extent)

	Other people in your school	People outside your school
a. Deepening your content knowledge		
b. Selecting course content and/or materials		
c. Addressing difficulties students may have with particular content ideas		
d. Implementing new teaching methods/strategies		
e. Modifying teaching methods/strategies that are not working as intended		
f. Ideas for increasing student interest/engagement		
g. Formally and/or informally assessing student learning		
h. Classroom management/discipline		
i. Communicating with parents/guardians and/or other community members		
j. Building professional community with other teachers		
k. Keeping informed about current trends and issues in the profession		
l. Understanding educational policy and the implications for teachers and students		

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