KALEIDOSCOPE:

EDUCATOR VOICES AND PERSPECTIVES

Photo by Genaro Vavuris

KSTF
Knowles Science
Teaching Foundation

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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. KSTF operates three programs that build national capacity for improving STEM teaching, leading, and learning: Teaching Fellows, Senior Fellows, and Research & Evaluation. To date, KSTF has supported nearly 300 Fellows in 44 states.

IN THIS ISSUE

Photo by Genaro Vavuris

WELCOME

We are pleased to publish our third issue of ***Kaleidoscope: Educator Voices and Perspectives.*** What was once a gleam in the eye of our Senior Fellows has blossomed into our very own grassroots, KSTF-flavored corner of the world of educational literature.

This year we've published articles on the unique experiences of teaching in Tanzania and writing letters to students' future selves. Fellows have tackled the art of multi-disciplinary environmental projects and how to bring KSTF into their schools. They've articulated the phases of engineering and mused about the challenges of leaving the classroom in order to move into school leadership roles.

As the editorial board reflects on the stellar articles published in the last two issues, two things immediately become clear: First, that the journal's budding vision of *sharing the knowledge and insight gained through our work in KSTF's unique professional network and providing substantive and reflective writing that is informed by our classroom practices and collaborative inquiry* has taken hold in a wonderful and creative way. And, second, that we are proud of this community of educators for having so much wisdom to offer the world of teacher education.

Without further ado, welcome to the Fall 2015 issue of *Kaleidoscope: Educator Voices and Perspectives*. We proudly encourage readers to share this issue with teachers, students, and anyone else who is interested in education. If you have any comments or questions, please contact us at kstf.journal@kstf.org.

INTRODUCTION

As teachers, we ask our students to take risks, to admit to uncertainty, to expose themselves as vulnerable in front of their peers—all in the pursuit of improving their understanding of the world around them. In writing the four articles presented in this issue, our authors make themselves vulnerable to our readers, through their stories of challenges accepted, mistakes made, and lessons learned. Through their writing, they open their classrooms and invite us all to share in their new understandings of our profoundly influential role as educators.

KSTF Senior Fellow Kelsey Johnson shares a lesson her students taught her about staying true to optimism through embodying a gratitude mindset. Her message transcends classroom outlooks and challenges us to re-engage in the promise of bright futures.

KSTF Senior Fellow Heather Buskirk found herself knee-deep in an engineering project on snowshoes after winter blew in to her physics course in February. Heather recounts how she tied engineering design to physics, math, and project-based learning to offer her students the challenge of the season.

2012 KSTF Teaching Fellow Tanya LaMar connects her personal struggle of evolving academic identity to resources that could benefit students who are dealing with similar identity issues. Tanya's story resonates for college-bound students and other students who feel conflict over decisions to stray from the norm of their communities.

KSTF Senior Fellows Kristin Germinario, Sarah Hawthorne and Laura Nutter were inspired to use 5 Practices (5P) instruction in their biology classes. Following successful attempts in their individual classrooms, they found opportunities for sharing their methodologies with local and national teacher groups, all the while increasing their personal understandings of the strength of 5P.

The *Kaleidoscope* Editorial Board welcomes all feedback. Please email our editorial board at kstf.journal@kstf.org.

OUR FUTURE SHOULD BE BRIGHT: ADVANCING A GRATITUDE MINDSET

BY KELSEY JOHNSON

Kelsey Johnson
Kelsey Johnson is a KSTF Senior Fellow whose curiosity about the natural world and love of the outdoors inspire her on a daily basis. While earning a master's degree in geochemistry from the University of Michigan, she researched trace-level mercury pollution in Arctic snow. While serving as a graduate student instructor for a field course in the Rocky Mountains, Kelsey discovered her passion for teaching. Kelsey taught science in the Philadelphia public school system for five years, including four years at George Washington High School and the founding year at The Workshop School, an interdisciplinary, project-based high school. She is currently launching an engineering program at Erie High School in Erie, Colorado.

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June 8, 2015. I committed malpractice while teaching Advanced Placement (AP) Environmental Science and only realized it the following year. My students struggled with the material and mutinied against me. At my wit's end yet still eager to salvage the course, I asked for help at my Knowles Science Teaching Foundation (KSTF) spring meeting. My KSTF Program Officer for Teacher Development at the time, Paul Wendel, suggested a style of class conversation that felt radically vulnerable for me. I decided to try it—what was there to lose?

I tasked students to create visuals about how the class was going for them while I went into the hallway to make a visual of my own. I drew a visual of a mountain whose pinnacle announced "Success!" at the end of a long, sinuous path. A class of stick figure students stood at basecamp with me, about to begin their trek to the summit, and I fervently cheered them on. I re-entered the classroom, traded posters with students, and retreated to the hallway to offer them privacy of discussion as we commented on each others' posters in marker. Finally, I returned and we all debriefed. Students were brilliant, and their feedback was both sincere and sensitive. Rather than simply cheering them from afar, students added images of me at each curve along the path, pointing and coaching students with *how* to navigate the challenging path to success. What transformed my perspective the most, however, was the orange sun a student drew next to the summit, annotated, "Our future should be bright." Therein held the key to my malpractice: I was teaching an environmental dogma of doom and gloom rather than how to discern evidence and logic from fallacious argumentation, or how to weigh risks in complex systems. I unwittingly painted a bleak future for students, substituting the age-old shame of original sin with the modern-day sin of consumption: because we must consume to live, and human consumption is killing the planet, our mere existence is something we ought to be ashamed of. Oops.

The American Dream, a notion that your hard work moves you toward a bright future, is optimistic by nature and polar opposite to the notion of doom and gloom. A recent national poll (Luhby, 2014) revealed that the majority of Americans do not believe in the American Dream or that it ever existed. When a person lacks faith in her agency to improve her lot in life, then her ambitions reflect that narrowed scope, actions become dampened and achievement subdued. Is there a pattern of moving away from optimism about

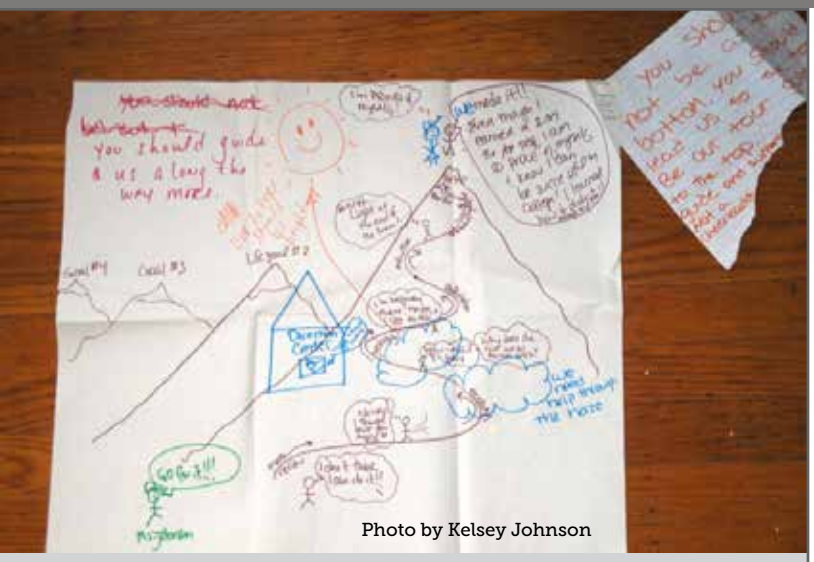

Photo by Kelsey Johnson

The brown mountain visual was created by KSTF Senior Fellow Kelsey Johnson; the other elements were added by her students.

our futures, as represented by the American Dream, taking hold in our collective psyche? If so, why? Social scientist Brene Brown (2012) identified shame as an epidemic in our society. She explains that shame decries, "I am bad," and narrows in one's sense of self-worth, whereas guilt declares, "I did bad," and can be reconciled without causing an identity implosion. Because shaming so effectively manipulates people to spend money (which they may not have) on material possessions (which they may not need), it surrounds us as a marketing tactic in the modern world. I've seen one concrete impact repeatedly: students flaunt expensive technology and sneakers while their more essential needs, like nutrition, suffered. There is a different way to allocate our material and emotional resources.

I propose something profoundly simple: a *gratitude mindset* whereby one practices noting and appreciating positive attributes of all situations. This idea is not new; I'm reframing a Zen adage, "In this moment nothing is lacking; in this moment there is always something to be grateful for." Similar to Carol Dweck's growth mindset, which cultivates learners' sense of intelligence as malleable and dynamic, a gratitude mindset cultivates optimism by emphasizing not what is lacking, but what is present. When we appreciate, we sidestep the contemporary conditioned response of shame for what we lack (in wealth, sex appeal, status, relationships, physique, material goods ...).

Well who cares? What if we let go of the American Dream? Let us take wisdom from Ma Joad, Steinbeck's (1939) heroine during the Dust Bowl of the 1930s, when her future was anything but bright:

> *She seemed to know, to accept, to welcome her position, the citadel of the family, the strong place that could not be taken. And since old Tom and the children could not know hurt or fear unless she acknowledged hurt and fear, she had practiced denying them in herself. And since, when a joyful thing happened, they looked to see whether joy was on her, it was her habit to build up laughter out of inadequate materials. But better than joy was calm. Imperturbability could be depended upon. And from her great and humble position in the family she had taken dignity and a clean calm beauty. From her position as healer, her hands had grown sure and cool and quiet; from her position as arbiter she had become as remote and faultless in judgment as a goddess. She seemed to know that if she swayed the family shook, and if she ever really deeply wavered or despaired the family would fall, the family will to function would be gone. (p. 74)*

A gratitude mindset cultivates optimism by emphasizing not what is lacking, but what is present.

Collective fear and shame pose risks greater than a family's broken dreams. German citizens' shame after WWI provided a leverage point for a young, charismatic leader who offered an antidote: superiority and nationalism. People traded their civic freedom for dictatorship, shame for nationalist pride. Shame provided an opportunity to manipulate the psyche of a nation, allowing Hitler to rise, legally, to power. Today leaders at all levels—from classroom teachers to elected officials, game designers to filmmakers—could cultivate optimism for a bright future that empowers people against the tide of shame, especially those forces being manipulated by people with nefarious intentions.

How does this relate to teachers? Harold Benjamin points out the urgency of having goals inform curricular design in his classic educational satire, *The Saber-tooth Curriculum*. Is our aim to "get these children to do the things that will give more and better food, shelter, clothing and security" (2004)? Individuals in modern society have needs beyond basic food and shelter, but can we *identify* our students' most pressing needs today, let alone address them? What do students need most in order to achieve a bright future? Let's ask the clinical experts: teachers.

Today leaders at all levels—from classroom teachers to elected officials, game designers to filmmakers—could cultivate optimism for a bright future that empowers people

KSTF Teaching Fellows from across the United States prioritized the needs for modern day education in a recent internal poll. We advocate for teaching basic literacy and numeracy within contexts of more complex topics such as how the systems that govern the Earth and the universe work, conflict resolution, financial literacy, media literacy, current events and foreign policy, nutrition and fitness, sex education and mental health awareness and strategies. Two participants summarized the big picture: "how shit gets done in the world," and "the overarching idea of how to think and exist in society as a full member. It speaks to issues of equitable access to big ideas that are commonly known by some and not by others." Clearly, there is much work to be done in classrooms to prepare students to be full members of society.

I am so grateful for my students' honest feedback and insight about my malpractice. The activity itself immediately changed the rapport of the class—they realized that I wasn't trying to embarrass them, and I realized that their mutiny was grounded in feelings of fear and the need of more support. Being willing to be vulnerable to hear each other's points of view was pivotal for this transformation. Moving forward, I explained the rationales for assignments more clearly so students understood how it was designed to benefit them, chunked assignments into smaller more frequent segments, and asked for feedback more often. Class became a learning environment for the first time that year. Students no longer mutinied; instead, they verbalized when they felt overwhelmed and the class psyche healed. May their lesson to me pay forward and help renew our collective will to thrive, to believe in the core principle that our hard work pays off, and to teach our youngsters to pursue the American Dream with imperturbability and a gratitude mindset. Their futures should be bright.

REFERENCES

Benjamin, H.R. W. (2004). Foreword. In Peddiwell, J. Abner, *The saber-tooth curriculum* (pp. VII-XII). New York, NY: The McGraw-Hill Companies. (Original work published in 1939).

Brown, B. (2012, March). Listening to shame [Video file]. Retrieved from http://ow.ly/T8vw2.

Dweck, C. S. (2007). *Mindset: The new psychology of success*. New York, NY: Ballantine Books.

Luhby, T. (2014, June 4). The American dream is out of reach. *CNNMoney*. Retrieved from http://ow.ly/T8vWo.

Steinbeck, J. (1939). *The grapes of wrath*. New York, NY: The Viking Press.

CITATION

Johnson, K. (2015). Our future should be bright: Advancing a gratitude mindset. *Kaleidoscope: Educator Voices and Perspectives*, *2*(1), pp 3–5.

MAKING THE MOST OUT OF WINTER WEATHER TO TEACH ENGINEERING DESIGN

BY HEATHER BUSKIRK

Heather Buskirk

Heather Buskirk is a KSTF Senior Fellow who teaches physics in Johnstown, New York. She graduated from University of Virginia in 2005 with a joint Bachelor of Arts in astronomy-physics and Master of Arts in science teaching. In 2013, she co-founded the Learning Project, a half-day program for seniors in the Johnstown School District, which integrates physics, math, English, and social studies through project-based learning. In addition to teaching, she serves as an instructional coach for Hamilton Fulton Montgomery Pathways in Technology School (HFM PTech), a new career focused school in her community. Heather works with the KSTF Engineering Task Force. She is also a New York State Master Teacher. In June 2015, Heather was appointed as the first teacher and Senior Fellow to serve on the KSTF Board of Trustees.

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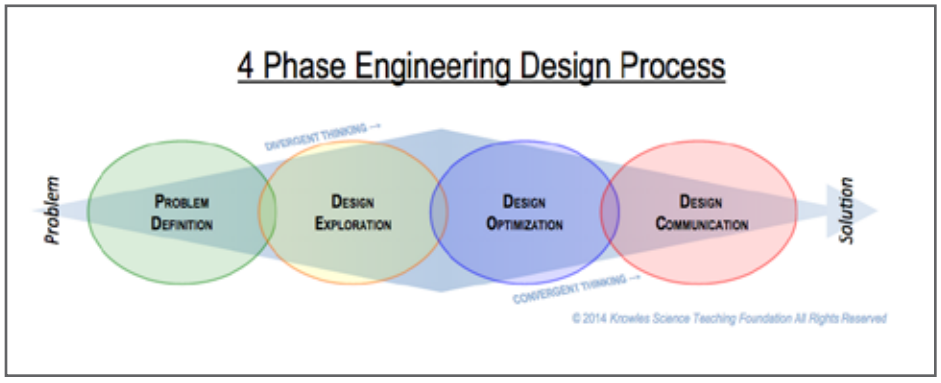
As any teacher of 12th grade students will tell you, February is when the symptoms start to appear. Cold and flu season may be winding down with the promise of longer days and warmer temperatures, but senioritis is just beginning and it only gets worse from here. I could already feel my students itching for the promise of freedom at the end of their final school year as soon as the new semester began at the end of January. With a February break only a week off, I knew I needed to build some momentum fast and get them excited to learn again.

We had over two feet of snow just outside the door of our classroom and the students kept jokingly asking to take class outside to build a snowman or have a snowball fight. This gave me inspiration for a snowshoe building project. I still had not covered pressure in physics class and my students could use some review on the differences between mass and weight. I also knew I could find some ways to build in some math skills as well. Furthermore, I could use this opportunity to provide my students with real experience with the engineering design process.

The Engineering Task Force (ETF) I had been working with through the Knowles Science Teaching Foundation had developed some resources I was eager to test out in my classroom. As part of our mission to build teacher capacity for incorporating engineering into the classroom, we had made our vision of the engineering design process more explicit and aligned with various classroom tools including rubrics, organizers, and checklists. While I have

Engineering Design Process Developed by KSTF Engineering Task Force



Photos by Heather Buskirk

done engineering design projects with my students in the past, they have always been adopted from already developed materials. This was the first time I was designing my own project. By using the ETF-developed resources I did not feel like I was starting from a blank page. I already had structures to help organize my thoughts and to think about my teaching and my students' learning systematically.

Using our representation of the design process, I laid out a graphic organizer for my students to record their work as they began defining the problem. "How can we design and build a snowshoe from recycled/scavenged materials?" From there they laid out criteria for success (e.g., keep from sinking into the snow, lightweight, easy to put on/take off, etc.) and identified the constraints both imposed by project and by nature. From there they worked through the process of brainstorming ideas, selecting a design, and making a plan to collect the needed materials.

ENGINEERING DESIGN PROCESS DEVELOPED BY KSTF ENGINEERING TASK FORCE

On our planned building and testing day, every student showed up on time and with materials. Too many times in the past, a scheduled in-class building day has proved fruitless when many students have been unprepared or absent. This time, they were all excited and eager to get started. They got to work immediately, fashioning their first prototypes from old crutches, PVC pipe, cardboard, duct tape, and more. As we were able to dedicate an entire three hour block to our work, the students had time to test and revise their designs. By the last half hour of class each team of students had their optimized design ready to show off. They eagerly trampled around in the snow and even engaged in a race to see whose shoes would hold up best. Only about half of the shoes survived the race.

The following day the students completed the calculations of pressure from their measurements and wrote up reflections on their designs. They justified design tradeoff and shared insights gained during the process. I confess I have rushed this part of the process, communication, or left it off entirely in the past. The time was well spent though. Through my students' writing and sharing, I gained greater insight into how they understood and engaged with the design process. Had the lesson ended with our tests results, I would not have seen how much some of my students were still struggling while their teammates breezed through.

Through my students' writing and sharing, I gained greater insight into how they understood and engaged with the design process.

Aside from the planned learning in physics and engineering design, the project presented a surprising learning opportunity in mathematics. In order to calculate pressure, the students needed to find the area of their snowshoe's footprint. Fortunately, none of the students had designed simple rectangles and so they had to think about finding the area of an irregular shape. I scaffolded the learning by having each student trace their own foot/shoe and find it's area. I did not tell them how, but made them defend and explain their approaches. Throughout the class they developed several different means of finding the area. A few of my most advanced math students who are taking calculus concurrently, had recently learned about Riemann sums and found the area by breaking the shape into

Photo by Heather Buskirk

For a few snowy days in February, physics, engineering, and math all came to play together in snowshoes.

a series of rectangles. Others broke the foot into a series of regular polygons including rectangles and half circles. A few more created a grid of 1 cm^2 boxes and counted up how many fit in the outline. In defending their choices to each other, seeing the limitations of the design, and in many cases, changing their approaches, they learned a great deal about mathematical thinking.

Whenever I try to explain project-based learning and integrating multiple subject areas in the classroom, I tell people to look for where the content plays together in the real world. For a few snowy days in February, physics, engineering, and math all came to play together in snowshoes.

CITATION

Buskirk, H. Making the most out of winter weather to teach engineering design. *Kaleidoscope: Educator Voices and Perspectives*, *2*(1), pp 6–8.

DO I BELONG HERE?: THE STRUGGLES OF OUR FIRST GENERATION STUDENTS

BY: TANYA LAMAR

Tanya LaMar
Tanya LaMar is a 2012 KSTF Teaching Fellow who teaches math at the Augustus Hawkins School in Los Angeles, California. In college, she came across a mathematics course that focused on critical thinking and reasoning through arguments. Once she overcame the challenge of thinking differently, a new world opened up to her. As a teacher, Tanya hopes to make mathematics more accessible to her students so that they too can experience success in the subject and gain confidence in their own intellect. Tanya holds a bachelor's degree in mathematics from California State University, Long Beach.

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"Maybe you think you're better than us because you went to college." These twelve words will always stick with me. Although they were said out of emotion and never meant to hurt me, they cut deep and made me question my identity.

As far back as I can remember my parents have taught me that I can achieve any goal as long as I dedicate myself 100%. It is because of my parents that I have reached the success that I have as a student, a teacher, and an adult. My mother and I have a close relationship. She is my best friend, my confidant, my shoulder to cry on, and my hand to hold. She's the person I call when I need to make an important decision, or when I have exciting news. She raised me to know my worth, but also to remain humble and gracious.

In high school, going to college was the expectation and the culture of my school and our community reflected this. I am the first person in my family to go to college, and my parents were supportive and proud of my self-advocacy. However, being a first generation college student did not mean much to me at the time. Everyone around me was going through the same motions and obstacles on the path to college and I did not feel any different.

I pursued a degree in mathematics at California State University, Long Beach and graduated with university honors. The process completely transformed for my identity and the way I evaluated my own intelligence. I had always identified myself as capable and felt confident in things like my likability or my ability to connect with people, but after becoming successful with mathematics, I felt confident in my mind, and this was incredibly empowering. This newfound confidence in my intellectual ability (and my dad's "just try it!" encouragement) led me to apply to the Stanford Teacher Education Program. The day that I was accepted is one of my proudest moments.

At first, I felt like an imposter at Stanford. I was one of only a few first generation college students. I could not identify with the narrative of most of my peers coming with bachelor's degrees from highly esteemed universities and families where multiple generations had attended college. I remember thinking, "Did they mean to pick me? Am I really as qualified as everyone else here?" It was difficult to believe that I actually belonged there. Thankfully, as classes got started, I felt valued and respected by the program and my peers. My identity as an educator for social justice was forming, and my intellectual

confidence was growing rapidly once again. I had opinions about education, equity, and social justice, and I knew how to talk about them.

Coming home to visit my family started to feel different. Being fully immersed in an academic environment where I regularly engaged in class discussions around important topics in education made me aware and alert about being careful and precise with my words. I had developed a watchful eye and critical ear for underlying sexism, racism, homophobia, and/or classism in people's statements or humor, and I felt that it was my duty to challenge these things. This was a stark difference from my unassertive, pre-grad school self, who shied away from any form of confrontation.

For my mother, these changes became apparent right away, and she was watching me change in ways she did not expect. I would challenge the things that my family said or the jokes that they made by pointing out how they were unintentionally hurtful to some group of people. To her, everyone was joking around and interacting with me in the way that we always had. To me, I was realizing how many parts of my life and culture that I had never taken a critical eye to. So, as I continued through my program the tension grew and I continued to feel distanced from my family. It seemed like I did not fit in like I used to.

The tension peaked in the first semester of my first year of teaching. My mother and I were on the phone and disagreeing over something. Although my mom and I have both tried to recall, neither of us can remember what we were arguing about. I was pushing back on something she said, and I felt strongly about it, but all I can remember are those twelve powerful words. She said, "Maybe you think you're better than us because you went to college." I stopped. The conversation fell silent, and I said, "Okay." The conversation ended shortly after, and as soon as I hung up I cried. My education that seemed like the ultimate achievement for myself had put a wedge between my family and myself. I knew she did not mean it—not in the way I interpreted it—but it still hurt just as bad.

Every time I revisit the story in my mind, I get emotional. I had worked so hard to make my family proud and to do the right thing. I went to college—check. I went to grad school—check. I started a career—check. I was supporting myself—check. Certainly these are the stepping-stones to a happy and successful adulthood. My upbringing, my school, my social group, television shows and movies all told me these were the steps I needed to take to achieve this ideal status as an educated and successful adult. But why didn't anyone tell me about the fact that I would change, and my family might not recognize me the same, and that I would identify myself differently?

Fortunately, being a part of the KSTF community provided me a with a space to begin to process these emotions. Reading *Why School*? by Mike Rose (2014)

As teachers, it is almost second nature for us to encourage our students to go to college—to chase the American Dream. But, do we take the time to at least acknowledge that this achievement comes with other transformations—that for some students we are encouraging them to depart from the world that they know and feel they belong in?

and discussing the book's themes and my own experience with other Fellows helped me feel like I belong in this community. Going to school was my choice, and I am thankful that I had so much love and support to get me there. Because of who I am and where I came from, my path to college was not full of too many obstacles. Despite being a first generation college student, I am still a white female from a middle class family. The demographic that I fall under still aligns closely with what our society portrays as a college attendee.

However, this brings me to my biggest concern and the conversation I want to start. What about our first generation students who come from disadvantaged backgrounds? If I struggled and continue to struggle with issues of identity and belonging in the academic world while coming from a culture where college was the norm, how deep are these struggles for our students who do not come from this same supportive culture? I have a student who comes from a family where every member works to help run their family store, and the expectation is that she will continue this tradition when she graduates. I have another student (and several like him) with a father in jail and family members in gangs. Each of my students is living in a community with poverty, gang violence, prostitution, and drug abuse. How can they possibly feel as though they belong in the academic world when they and the people they love live in a starkly different world?

As teachers, it is almost second nature for us to encourage our students to go to college—to chase the American Dream. But, do we take the time to at least acknowledge that this achievement comes with other transformations—that for some students we are encouraging them to depart from the world that they know and feel they belong in? Is there a place for this conversation in high school? Are our students already thinking about it?

I decided to ask my students. For context, I teach at a public school in the area my students refer to as South Central Los Angeles. Our population is 85% Latino and 15% African American, with 77% of our students eligible for free and reduced lunch. I provided my senior students with a survey about their families' and friends' reactions to their plans for after high school. Almost every student reported that their family and friends were both excited and supportive with the exception of one student whose parents were disappointed that he had chosen community college over the California State Universities he had been accepted to.

The most interesting responses were to the question: "What (if any) were some of the concerns that you considered when deciding to go to college?" I provided a list of things for students to select and directed students to choose all of them that applied. I found that at least one fifth of my students considered how college might cause their friends and family to see them differently. Although these numbers are small, they do show that these concerns are present for some students, which leads me to believe that this is a conversation worth having as educators.

Within the high school setting there are some ways that we can support students in defining their identity and cultivating a sense of belonging in the academic world. At my school, we have implemented an advisory program where each teacher has a grade level advisory of approximately 25 students. Students have the same advisory group and teacher for all four years of their high school career. In this space, we focus on community building and college and career support. As students progress through high school, advisors support students with things like writing their personal statements, filling out college applications, and completing FAFSA (Federal Student Aid Application) and scholarship applications. Additionally, advisors make connections with students' families to involve them as much as possible in the student's education and choices for after high school. With this advisory program, we can ensure that every senior has at least one adult in their life who they can reach out to for support in navigating the post high school world.

Another option to support our first generation college students could be to start a mentoring program between recent first generation college graduates and high school students coming from the same community. Within a program like this, students could connect with a college graduate who may not be much older than them and discuss some of the challenges of transitioning to college. Perhaps a program like this could begin to help students feel as though they belong. Additionally, it could be helpful to have a community of people sharing the same experience to help one another process the many emotions that occur during such a life changing journey.

Becoming educated is empowering and one of the most beautiful processes a person can delve into. Becoming the first person in your family to graduate from college is a major accomplishment and can boost your self confidence in unexpected ways. However, becoming educated means changing and it can mean changing one's identity–not changing, to become a different person, but changing in the way that growth changes a person. Additionally, it can be difficult at times to believe that one belongs in academia. My experience has taught me that these transformations are impactful and emotional. As my identity has changed, I have experienced a feeling of distance from who I once was and the categories I used to fall under. After speaking with my students, I can see that many of them may experience the same struggles that I have and could benefit from having support in this area. I hope that we, as educators, can work together to support our students as they process the development of their identities and embark upon the path to college. We are the ones who have the ability to teach first generation college students that they do belong in the academic world and I believe it is our duty to do.

REFERENCE

Rose, M. *Why school? Reclaiming education for all of us*. New York, NY: The New Press.

CITATION

LaMar, T. (2015). Do I belong here?: The struggles of our first generation students. *Kaleidoscope: Educator Voices and Perspectives*, *2*(1), pp 9–12.

EXPANDING PROFESSIONAL DEVELOPMENT ON A NATIONAL SCALE:

HOW INQUIRING INTO STUDENT LEARNING THROUGH THE 5 PRACTICES METHOD TRANSFORMED TEACHERS' PRACTICES AND IMPACTED EDUCATORS NATIONWIDE

BY KRISTIN GERMINARIO, SARAH HAWTHORNE, AND LAURA NUTTER

Kristin Germinario
Kristin Germinario is a KSTF Senior Fellow. She has been teaching biology at Randolph High School in Randolph, New Jersey, since 2011, where she is known for her active collaboration with colleagues through facilitating professional development sessions, serving as a teacher mentor, developing interdisciplinary lessons, and participating on the team of teachers who are piloting an Advanced Placement Capstone program. As a KSTF Fellow, Kristin has brought Project Based Learning, the 5 Practices, and Complex Instruction strategies to her classroom. Kristin involves her students in engineering design challenges through her experiences with the Center for Innovation in Engineering and Science Education's Project Infuse, and actively films and produces her own nature videos for her classroom based on her experiences with the Inquiry in Rainforests Program. Kristin holds a bachelor's degree in biology with a minor in studio art and public health, and a master's degree in teaching from Drew University.

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In order to design instruction that fosters the development of scientific practices in students, teachers study and inquire into student learning. As a group of biology Teaching Fellows from the Knowles Science Teaching Foundation (KSTF), we share a common goal of inquiring into how students learn science to provide opportunities for deeper learning in our classrooms. Jen Cartier of the University of Pittsburgh introduced us to the Five Practices (5P) for orchestrating productive class discussions during a meeting of the KSTF community (Cartier J., Smith M., Stein M.K. & Ross, D., 2013). Most of the literature at that time explained the use of the 5P for mathematics tasks, and the 10 of us who teach biology decided to pursue its application in our classrooms as well. This article explains how we developed our understanding and shared our knowledge of 5P with other teachers, both locally and nationally, and how this process gave us a deeper understanding of 5P itself.

OUR INITIAL WORK AROUND THE FIVE PRACTICES (5P)

Traditionally, classroom lessons that involve problem solving and presentations have student groups engage with one particular task. During class presentations, student groups each present their entire solution to the same problem. During these presentations, it is difficult for teachers to emphasize important student understandings in a coherent, productive narrative. Additionally, students may stop paying attention after the third or fourth identical presentation. However, by using the 5P, teachers present student groups with cognitively demanding tasks that require them to generate multiple solutions, make comparisons, or identify patterns in data. Following student work on the task, the teacher sequences the presentations in such a way that no two groups are presenting the exact same idea. As a result, students see the "story" behind the lesson's main idea unfold as different groups explain their part. Before students even begin working on the task, the teacher follows a series of steps to structure the discussion as outlined in *5 Practices for Orchestrating Productive Mathematics Discussions* (Smith & Stein, 2011).

Prior to the lesson, teachers *anticipate* how students will engage with the task, considering multiple outcomes and possible roadblocks students will encounter. As students engage with the task, the teacher *monitors* the progress of each group. After task completion, the teacher selects portions of student findings to share with the class, and *sequences* the responses into a narrative. This differs from traditional presentations because student groups only present

certain information. For example, in an experimental design task used in a biology classroom, some student groups present on their lab setup while other groups present their data analysis. Finally, during discussion the teacher assists students in connecting ideas centered around the essential understandings.

Since there was not a sufficient library of tasks to support this 5P approach in biology, we wished to spend time developing biology tasks for our classrooms. Using KSTF professional development funding, we designed our own workshop where we developed tasks in biology. One teacher, Sarah Hawthorne, designed a task around genetic counseling to help students decipher inheritance patterns and pedigrees. Another Fellow, Laura Nutter, created a task around the evolutionary patterns of ensatina salamanders as a ring species. Additionally, several teachers created a "membrane task" where students design models to test selectively permeable membranes (See http://ow.ly/QPnv3).

We then implemented these tasks in our classrooms and continued to review, reflect, and revise the tasks and their method of implementation. For instance, when using the membrane task, teacher Kristin Germinario found that the task generated more rich discussion around the design and testing of model systems in addition to content. In a typical diffusion lab each student group designs the same test and achieves the same result; in this case, student groups were excited to see the results of their unique design and share their part of the overarching story with the class. Through this process, we began to learn more about the nuances of the 5P and wanted to create a way for other teachers to learn about the 5P process.

"After using some of the 5P tasks in my classroom, I realized that it was a great way to conduct student discussion, and I wanted to tell other teachers about it."
-Laura Nutter, KSTF Senior Fellow

SMALL-SCALE WORKSHOPS WITHIN OUR OWN LOCAL SCHOOL CONTEXTS

We began sharing our work with others through workshops and small-scale presentations. One Fellow within the cohort, Sarah Hawthorne, presented about 5P at a regional POGIL (Process Oriented Guided Inquiry Learning) workshop in Colorado, as well as to a group of colleagues at her school.

As a result, at least two teachers in her department showed interest in trying 5P and observing the Practices in classrooms. Additionally, colleagues provided feedback on the presentation. One teacher commented that 5P was the first method she had seen that allowed students to both practice problem-solving skills while also engaging in content—a concern for her because of new Next Generation of Science Standards (NGSS) standards. This process allowed us to meet two major goals: disseminate knowledge of 5P to others, and receive feedback on our presentation. This practice and feedback motivated us to share our knowledge of 5P on a larger scale.

"When I saw that my colleagues were really interested in 5P, and wanted to try the things I was talking about, I realized that what I had to share was worthwhile. And if my colleagues were interested, maybe other teachers around the country would be, too."
-Sarah Hawthorne, KSTF Senior Fellow

We also saw KSTF's annual Summer Meeting as a good opportunity to share 5P with a larger group of teachers.

LARGER-SCALE PRESENTATION TO MATH AND SCIENCE TEACHERS AT KSTF SUMMER MEETING

Using the feedback received from the smaller workshop presentations, we designed a presentation for our first interactive workshop on 5P at the 2013 KSTF annual summer meeting. Four teachers from the cohort—Laura Nutter, Kristin Germinario, Nicole Lien, and Emma Ross—collaborated prior to the meeting to develop a presentation with sample tasks to share with other teachers. During the presentation that summer, other members of the cohort—Rachel Clausen, Brittney Barickman, Helen Snodgrass, and Sarah Hawthorne—observed the presentation and took notes. In addition, our KSTF Program Officer for Teacher Development Michele Cheyne recorded the presentation. After the presentation, the presenters gave questionnaires to participants for their feedback. As presenters, we learned even more about the 5P method itself by having other Fellows experience the 5P as participants.

"When designing the presentation of 5P for other KSTF Fellows, it pushed me to truly understand how the practices are used to orchestrate classroom discussions.

Sarah Hawthorne

Sarah Hawthorne is a KSTF Senior Fellow who teaches science at Mountain View High School, a comprehensive public school near San Francisco, California. She enjoys finding new ways to help her students engage in complex topics related to biology, earth, and environmental science. In March 2015, a blog she wrote about her second year of teaching was published on the Education Week Teacher blog. Sarah holds a bachelor's degree in biological sciences, with honors in ecology and evolution, and a master's degree in education from Stanford University.

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Laura Nutter

Laura Nutter is a KSTF Senior Fellow. She has been teaching biology at TC Williams High School in Alexandria, Virginia, since 2011. In 2014, Laura was accepted into the third cohort of the AP Biology Leadership Academy, run by the National Association of Biology Teachers (NABT) and BSCS. The NABT/BSCS AP Biology Leadership Academy is a two-year professional development program designed to develop a new generation of leaders in biology education. Additionally, Laura was elected to serve as the chairperson of the Staff Advisory Council at her school. During the 2015–2016 academic year, she will lead the 20-member group as they meet with school administration on a monthly basis to discuss questions and concerns. Laura holds a bachelor's degree in biology from Duke University and a master's degree in education from Harvard University.

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I do not think I truly understood the 5P until after presenting it to other colleagues."

-Kristin Germinario, KSTF Senior Fellow

In addition to giving us the opportunity to collaborate, this experience at KSTF's summer meeting gave us valuable feedback from other Fellows. The feedback encouraged us and helped us see the importance of presenting to wider audiences.

SESSION FEEDBACK FROM KSTF FELLOWS:

"I found it to be rather helpful in getting students to be at the center of classroom discussions. All too often mine have been students sharing their results and finding and it being repeated over and over. This was an interesting way to organize a "story" and have students check in at different parts to complete the story."

"Seriously, this was a fantastic session, and I walked away feeling like I could use pieces to make more really awesome class discussions this upcoming year."

We not only learned more about the process of 5P, but we also gained the confidence to take our presentation to the national level.

NATIONAL-SCALE PRESENTATIONS AT NSTA AND NABT CONFERENCES

Immediately following the KSTF presentation, our cohort met to debrief the presentation. Together we combined the presenter's thoughts with the notes from the observers to strengthen and modify the presentation for the National Association of Biology Teachers (NABT) Conference, which was held in Atlanta in November 2013. One topic we discussed was the balance of the presentation—the amount of time that the presenters spoke versus the amount of time the participant had time to work and practice. Participants at the KSTF summer meeting appreciated this practice time, and one noted that what she found "particularly useful" about the session was "walking through the planning stages for the Practices." Another participant wrote "It was great to...have some experience trying out the Five Practices framework!" This hands-on experience with 5P was clearly important to participants' learning.

Photo by Andrea Cipriani Mecchi

Based on this feedback, we decided to reserve as much time as possible for participants to work through the Five Practices on their own. As a result, a major change was made between the KSTF summer meeting presentation and the later presentation at NABT: we decided to give fewer examples of 5P classroom tasks, and we did not spend as much time on the Practice of setting goals, so that participants could engage more quickly with the Practices of *anticipating, monitoring, and selecting*.

KSTF Fellows Helen Snodgrass, Brittney Barickman, and Rachel Clausen then brought the presentation to NABT. KSTF Program Officer for Teacher Development Michele Cheyne also attended this presentation and met with the presenters afterward to record their thoughts and feedback on the presentation. They aggregated the data from participant feedback along with our own reflection to provide a working document for the next team of Fellows, Laura Nutter and Sarah Macway, to use to further enhance the workshop for the National Science Teachers Association (NSTA) national conference in Boston in March 2014. From the NABT participant feedback, we learned that participants appreciated the interactive parts of the session and would like even more time to work on developing their own 5P lesson plans. We adjusted our presentation to include more opportunities to practice and less direct instruction, such as the directions included below:

> Work with your group to create a monitoring tool that you could use to track student progress in your classroom. You may choose to make a tool to track an activity you already have planned so you can see how this practice is beneficial in any student-inquiry activity. *From the NSTA 5P Slideshow*

At this point in our presentation series, we realized the importance of making the presentations as relevant to other teachers as possible. Not only were teachers more engaged in the workshop, but they began thinking about ways to apply it to areas we had not explored, such as physical science and middle school courses. The process seemed to come full circle as we were now learning about our own product from the very people we were trying to teach it to.

THE IMPACT OF OUR WORK: ONGOING NATIONWIDE COLLABORATION AND DEEPER UNDERSTANDING OF THE FIVE PRACTICES

As a result of this initial series of iterations, we hope our work with 5P will spread nationally. Other teachers across the country, including KSTF Fellows in other cohorts, are engaging their students with inquiry tasks. These teachers are also inquiring into their own practices as they improve and develop the 5P to work best in their individual settings. With support from KSTF, we were able to learn about a method of orchestrating classroom discussion, develop tasks around this method, and grow in our understanding and confidence to share our ideas with others. Furthermore, in developing presentations on the 5P to educate others, we improved our own understanding of the 5P. Working together on the presentations allowed us to talk through what we saw as the most important points of the 5P and to discuss what it looked like in our various classrooms. In teaching others about 5P, we deepened our own knowledge of this inquiry method. Having the opportunity to revise our presentation helped us to realize that teachers gained the most from sessions that created an experience relevant to teachers' own contexts and provided ample time for teachers to engage with the 5P.

Our desire to share 5P stemmed from our own passion about implementing it in our classrooms. The benefits students gain from asking and answering their own questions are invaluable in science education, especially as the demands of the NGSS require more independent skills from students.

For teachers, the excitement of allowing students time for self-discovery while being confident that they can guide students' content knowledge development is an incredible tool. Though none of us could have predicted how much our own ability to implement 5P with students would improve through teaching it to adults, we saw our classroom practices change as we developed our own understanding through the workshops we implemented. We are all very proud to have developed this tool. We are also extremely grateful for the power of collaboration and our ability to work together as a group of dedicated and passionate teachers to affect education on a national level.

REFERENCES

Cartier J., Smith M., Stein M.K. & Ross, D. (2013). *5 practices for orchestrating productive task-based discussions in science*. Reston, VA: National Council of Teachers of Mathematics.

Smith, M.S., & Stein, M.K. (2011). *5 practices for orchestrating productive mathematics discussions*. Reston, VA: National Council of Teachers of Mathematics.

CITATION

Germinario, K., Hawthorne, S. & Nutter, L. (2015). Expanding professional development on a national scale: How inquiring into student learning through the 5 practices method transformed teachers' practices and impacted educators nationwide. *Kaleidoscope: Educator Voices and Perspectives*, *2*(1), pp 13–17.

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