THE DEVELOPMENT & GROWTH OF THE MAKER MOVEMENT IN SONOMA COUNTY SCHOOLS

Cultivating a Maker Educator Network across K-12

Abstract

This case study highlights the growth of Sonoma County's maker educator network by identifying key stakeholders and pivotal moments of opportunity and partnership. Through radical collaboration and a bias towards action, we have been able to rapidly expand making in our local educational settings. We believe that our partnership and the core values and learning principles of making have the ability to empower all K-12 students and engage them in educational experiences that are meaningful, rigorous, and innovative.

KEY PARTNERS

The organization and development of a maker movement in Sonoma County requires the participation of educators, students, parents, local businesses, and volunteers. The following is a list of educational leaders who were instrumental to the design, coordination, and implementation of making and makerspaces in our local community and school system.

Dr. Carlos Ayala, Dean, School of Education, Sonoma State University
Carlos Ayala has taught courses on secondary science methods as well as courses of quantitative research methods at University of California at Davis. His current research focuses on understanding student science learning through formative assessment, and computer science simulations for learning and assessment.

Melissa Becker, Principal, Meadow Elementary School, Petaluma, California
Melissa Becker received the Petaluma Community Award for Excellence in Education in May 2014 for her charismatic leadership. She created a makerspace for students and strives to provide a progressive learning environment for all children.

Dan Blake, Director of Innovation & Partnerships, Sonoma County Office of Education
Dan Blake has 21 years of experience in education, the last eight as an administrator at the Sonoma County Office of Education. Dan oversees SCOE's efforts to promote 21st Century teaching and learning in local schools.

Dale Dougherty, Founder & CEO Maker Media, Inc., Sebastopol, California
Dale Daugherty is the founder of *MAKE: Magazine* and *Maker Faire* which are produced by Maker Media, Inc., where he serves as Executive Chairman.

Dr. Steven Herrington, Superintendent, Sonoma County Schools
Dr. Herrington began his career in education as a history teacher. He served as superintendent for three Northern California school districts, gaining experience in rural, suburban, and urban settings and overseeing educational services for students.

Dr. Jessica Parker, Associate Professor, School of Education, Sonoma State University
Jessica Parker is an expert in educational technology, digital media and learning, and new literacies. She is the Director of the Maker Certificate Program at Sonoma State University, and the author of *Teaching Tech-Savvy Kids: Bringing Digital Media into the Classroom*.

Mickey Porter, Deputy Superintendent, Sonoma County Office of Education
Mickey Porter has been an administrator in education for the past 24 years as a middle school principal, district superintendent, and regional program director. She is passionate about building the leadership capacity of those around her and supporting others in growing in their areas of expertise.

Casey Shea, Teacher, Analy High School, Sebastopol, California
Casey Shea teaches math and leads the Project Make at Analy High School. Following a pilot year in 2011 at the Make headquarters, Project Make moved into an old shop building on campus and has continued to grow each year with the suport of the school and community at large.

Gina Silveira, Principal, Schaefer Charter School, Santa Rosa, California
Gina Silveira is an innovative administrator with 16 years of classroom experience and three years in administration. Last summer she ran a maker camp for students and was inspired to continue to infuse making and engineering throughout the elementary curriculum.

Dr. Jennie Snyder, Superintendent, Piner-Olivet Union School District, Santa Rosa, California
Jennie Snyder is passionate about facilitating innovative learning in her district for students and adults. Prior to becoming a superintendent, Jennie served as a school principal, charter school site administrator, and a middle school humanities teacher.

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This case study was written as a team by key stakeholders in Sonoma County including, Jessica Parker, Melissa Becker, Dan Blake, Stacey Lince, Mickey Porter, Casey Sears, Casey Shea, Gina Silveira, Jennie Snyder and Pamela Van Halsema.

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I. INTRODUCTION

The concept of making has long been a part of Sonoma County culture. Sonoma County, a mid-sized rural community with just over 500,000 residents, is located 35 miles north of the San Francisco Bay Area and nestled between the Pacific Coast and the Napa Valley.

Though most notably known for our vineyards and the birthplace of the California wine industry, the principles of making, tinkering, and innovation have historically been integral to our local economy. From pioneer vintner Count Haraszthy and the growth of Buena Vista, California's first premium winery, the invention of the egg incubator in 1881, Luther Burbank's influence upon agricultural science, to the development of what came to be known as Telecom Valley, we have long considered ourselves makers.

Like Sonoma County's agricultural history, the growth of a collaborative network of maker educators in our rural county was an organic process. We realized the resurgence of making was an opportunity for youth to investigate their worlds and engage in creative problem solving. Because we came together around the shared goal of empowering K-12 learners, making became an entry point to support K-12 teachers in implementing activities and curricula infused with play, inquiry, design, and problem-posing and problem-finding. As we collaboratively entered into the processes and production of making and tinkering, we began to develop our collective definition of making: to make something that mattered. This two-pronged vision—to empower K-12 learners and engage them in making that mattered—has driven our approach to maker education and fostered a uniquely local approach to professional development and school change.

Our resulting partnership between community leaders, school districts, Sonoma State University, and the Sonoma County Office of Education is built on radical collaboration. This relationship was not built overnight, but evolved as educators implemented their own maker-related activities in local K-12 settings. We came together as a group to share our experience, learn from one another, and discuss ways to support educators and learners with limited resources. As we entered into conversations, we wanted our process to be inherently collaborative and mission driven, not simply a promotion of individual pursuits or a competition to promote individual institutions. Most importantly, all stakeholders shared a common belief that our partnership and the core values and learning principles of making have the ability to empower K-12 students and engage them in educational experiences that are meaningful, rigorous, and innovative.

The following case study highlights the growth of our maker educator network by identifying key stakeholders and pivotal moments of opportunity and partnership. Through radical collaboration and a bias towards action, we have been able to rapidly expand making in our local educational settings.

An important postscript:

We have been fortunate to be able to stand on the shoulders of giants, including amazing researchers and practitioners, in an effort to learn about making and maker education. Our understanding of making and the Maker Movement emerged from a collection of resources, readings, and ongoing conversations with a number of thoughtful maker educators; we have woven their words and resources throughout this document in order to acknowledge the pioneers that have paved the way and we thank them for their insights, support, and wisdom.

II. MAKER CORE VALUES

"The maker movement is an innovative way to reimagine education."

-Kylie Peppler and Sophia Bender, 2013

So often in a traditional classroom learning is focused on a student's mastery of a specific skill or task. For many, this kind of learning lacks relevance and is devoid of context or application. Additionally, a discipline-specific curriculum often overemphasizes breadth rather than depth of content knowledge. Plus, school-based learning and assessment is often individualistic in nature. A student's grades are her own: she takes a test by herself and usually completes her homework by herself. Yet, real life is often about collaborating and communicating with others and analyzing a problem or challenge with a team of people.

What is Making?
Northern California educators discuss their definitions of making in their respective classrooms and schools.

In a time when traditional school-based learning feels disconnected from the realities of the 21st century, we felt that making presented an opportunity to refocus teaching and learning and rethink school spaces. We turned to educators working with youth in out-of-school settings, such as Karen Wilkinson and Mike Petrich from The Tinkering Studio at the Exploratorium in San Francisco, for insights into the power of tinkering and making. In *The Art of Tinkering,* Wilkinson and Petrich (2013) explain tinkering as:

> *...fooling around directly with phenomena, tools, and materials. It's thinking with your hands and learning through doing. It's slowing down and getting curious about the mechanics and mysteries of the everyday stuff around you. It's whimsical, enjoyable, fraught with dead ends, frustrating, and ultimately about inquiry...Because you tinker, you're not following a step-by-step set of directions that leads to a tidy end result. Instead, you're questioning your assumptions about the way something works, and you're investigating it on your own terms. You're giving yourself permission to fiddle with this and dabble with that. And chances are, you're blowing your own mind (p.13).*

By refocusing teaching and learning on "thinking with your hands and learning through doing," we began to witness the excitement of students who were engaged in making; they were having their minds blown! By rethinking school spaces and creating makerspaces with a focus on "phenomena, tools, and materials," students had opportunities to explore through play, inquiry, and iteration. We began to see how much of their learning took place when their attempts were unsuccessful. Rather than looking for a correct answer or moving on to the next task, students were reflecting on the process, collaborating with their peers to find a workable solution, revising their plans, taking risks, and trying it all over again. We were thrilled to find these maker-based experiences to be authentic and innovative and it deepened students' understanding of content as well.

We believe that the foundation of making is based on a participatory and peer-based culture of learning in which "everyone is a maker" and "everyone is a learner," including all adults in the room. Making is about building a learning community with a low barrier of entry. Seymour Papert (1993) and Mitch Resnick (2005) emphasize developing tools for learners that have a "low floor" (e.g., easy to get started) and a "high ceiling" (e.g., opportunities to create sophisticated projects) and "wide walls" (e.g., supporting many different types of projects).

Our East Bay colleague, Aaron Vanderwerff, from Lighthouse Community Charter School in Oakland, CA discusses why making is powerful.

Within this learning community, making is collaborative and inherently social; sharing one's processes and work, giving and receiving feedback from peers and experts, and reflecting on the overall experience and potential product is embedded in the social fabric of making. Social in this case is about "messing around" and "geeking out" (Ito, 2009) over hands-on projects and activities that invite students to make deeply, are challenge and problem-based, and offer learners choice in their making pursuits. We have found that the key to the implementation of making in K-12 classrooms and after-school settings has been to allow students to be at the center of the learning experience.

Below is a table of core values and principles of a maker mindset that we find helpful to discuss with practitioners. These values and principles were developed out of our own practice and should be viewed as a jumping off point to designing maker-based projects and activities. We recommend that educators engage in making and then begin to analyze the learning and design principles that resonate with them.

Core Values	Learning Principles	Design Principles
• Everyone is a maker • Everyone is a learner • Making is social • Hands-on • Stewardship & Sustainability	• Value in process and product • Collaboration • Choice • Ample time • Reflection, documentation, and sharing • Barrier of entry: "low floors, high ceiling, wide walls"	• Student-centered • Challenge and/or problem posing • Iterative design • 21st Century Learning: authentic, relevant, creative, and open-ended

Figure 1: Maker Mindset in Educational Setting

We have found making in K-12 to be most successful when it is about making things that matter.[1] We currently use making and a maker mindset as vehicles to design learning opportunities in K-12 settings (e.g., classrooms, after school settings, libraries, etc.) that are:

- Authentic, relevant, purposeful
- Student-centered
- Playful and experiential
- Hands-on
- Problem/challenge focused through inquiry, design, tinkering, and making
- Reflective of process and product
- Interdisciplinary
- Deeply participatory and content-rich (e.g., depth over breadth of content)

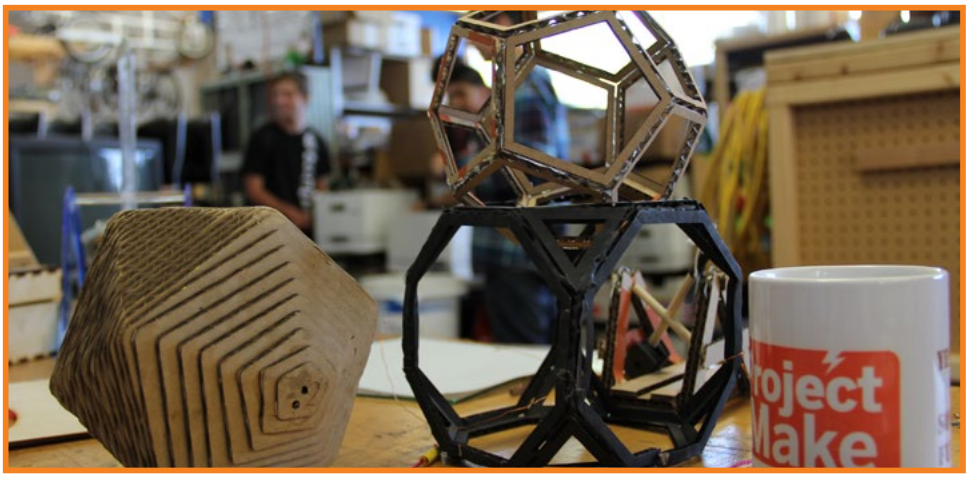
1 Learn more about "making that matters" through discussions of Constructivist and Constructionist frameworks. These frameworks have a rich history within progressive education dating back to John Dewey, Maria Montessori, Jean Piaget, Paulo Freire, and Seymour Papert. Current discussions include, but are not limited to, Halverson and Sheridan's (2014), The Maker Movement in Education; Christa Flores' (2015), Fostering a Constructionist Learning Environment: The Qualities of a Maker Educator blog post; The Tinkering Studio's (2015) free online course, Tinkering Fundamentals: A Constructionist Approach to STEM Learning, https://www.coursera.org/course/tinkering; and Karen Wilkinson's Making Tinkering, & Design keynote for the K-12 Online conference: https://vimeo.com/110200853.

Throughout this case study we share examples of maker educators who have designed and implemented maker activities in an effort to empower their K-12 learners and make learning experiences that matter. We highlight these educational leaders and their accomplishments because it points to the iteration of ideas within the Sonoma County maker movement. The growth of our maker educator network is based on educators taking action and inspiring others to do the same. As our colleague Aaron Vanderwerff says,

"Making and design and inquiry and a student-centered mindset could be revolutionary to education as a whole if we all take it on."

The Importance of a Maker Mindset
Maker educator David Clifford, from East Bay School for Boys in Berkeley, CA, discusses the importance of a maker mindset.

III. MAKING IN SONOMA COUNTY SCHOOLS



Project Make: Dale Dougherty and Casey Shea

Sonoma County can trace its most recent roots in the Maker Movement to the publication of Dale Dougherty's *Make: Magazine* through O'Reilly Media in Sebastopol, California in 2005. Local technology enthusiast, Dale Daugherty's belief that "we are all makers" inspired him to found Make: and launch the first *Maker Faire* in 2006 as a way of connecting makers and tinkerers to resources, networking opportunities, and venues to showcase their products, creativity, and innovation.

In 2008, Casey Shea, a math teacher at Analy High School, chaperoned a field trip to a local Maker Faire. When he realized the Maker Faire was hosted by a local Sebastopol company, just a short walk from his campus, Casey thought how unfortunate it was that the two organizations were not working together and providing more opportunities to students for hands-on-learning. A unique partnership emerged two years later with the union of Analy High School and Make:. Dale Daugherty approached West Sonoma County Unified High School District superintendent Keller McDonald and Casey Shea with an offer to host a new maker class at Maker Media, Inc. headquarters. They leapt at the opportunity and the first North Bay maker class was launched during the 2011-2012 school year.

Math teacher, Casey Shea, is a tinkerer with a friendly smile and an openness that invites people to just drop off their spare parts at his doorstep.

The first class, proved to be an eye-opening experience for students, teachers, and administrators from around the Bay Area. With access to both low- and high-tech tools and materials along with a student centered curriculum, the class served as proof of the concept that making in schools could work.

The success of Analy's new maker class led to the establishment of *Project Make*, a hybrid project that is part 21st century shop class, part science, technology, engineering, and mathematics (STEM) sandbox and tinkering studio and part entrepreneurial incubator. With donations from Maker Media, Inc. and local groups like the Rotary Club, Analy converted an old shop classroom into a large makerspace and supplied it with tools such as a laser cutter, vinyl cutter, 3D printer, and CNC router. The overall goal of Project Make is "to encourage active learning and help develop the maker mindset in students." Currently there are three sections of the course at Analy, and a number of teachers incorporate making and the makerspace into their core curriculum for special projects.

ieSonoma: Innovate and Educate through Community Partnerships

Concurrent to increased participation in maker activities and Maker Faires in Sonoma County, a partnership between public and private education institutions and the larger community also began to blossom. In June 2013, *ieSonoma: innovate | educate* launched its first annual symposium, co-sponsored by the Sonoma County Office of Education, Sonoma State University (SSU) and Sonoma Country Day School, a private K-8 school. Devoted to exploring the research, theory, and practice of 21st century teaching and learning and preparing youth for success, ieSonoma hosts events in order to launch ideas, spark community conversations, and foster radical collaboration.

Dale Dougherty was a featured keynote speaker at the inaugural *ieSonoma symposium* in 2013. Dougherty's emphasis on envisioning students as producers rather than consumers and his reflections about his involvement with Analy High's Project Make and a local Maker Camp at Comstock Middle School inspired many teachers and administrators to reflect on their own teaching practice and consider how they might inconcorporate making and makerspaces in their own schools.

The First K-5 Maker Lab in Sonoma County: Melissa Becker

Within a year of attending the ieSonoma symposium featuring Dale Dougherty, Melissa Becker, Principal of Meadow Elementary School in Petaluma, California, introduced making and a Maker Lab to her K-5 students. It was the first K-5 makerspace in the North Bay at the time.

Melissa is an energetic and enthusiastic leader, and she knew that creating buy-in from students, parents, and colleagues for the new makerspace was essential. Her first instinct was to start gathering supplies for the new space, which was housed in a portable classroom. She did this through a Ziploc challenge.

Melissa gave each student a Ziploc bag and asked him or her to fill it with supplies that could be used in the new makerspace. She also asked families to supply non-working electronic equipment such as telephones and computers that could be taken apart and repurposed. In taking the equipment apart, students were able to see the inner workings of machines and also explore how each part had a purpose. As the supply collection began to grow and student and parent excitement began to build, Melissa realized she would need assistance in the Lab. She sent home a volunteer sign-up sheet inviting parent volunteers to work 30-minutes per week in the lab. The response was overwhelming. Not only was Melissa able to staff the lab with 25 volunteers, a parent also volunteered to coordinate the space and its growing number of supplies.

Maker Lab feels authentic to students. It is bursting with random, unfamiliar materials in which to explore, play, and learn! When making in the Lab, there are three rules for their space:

- RESPECT EACH OTHER AND THE MATERIALS.
- PUT EVERYTHING BACK EXACTLY WHERE YOU FOUND IT.
- HAVE FUN!

From a pedagogical perspective, Melissa wanted the makerspace to be viscerally different from a traditional classroom. For her, the Maker Lab required a different kind of teaching and a different approach to learning. Oftentimes in a makerspace, teachers design opportunities for students to engage in tasks in which the outcomes are not already determined—there might be many ways to work through a problem or challenge that does not have one *right answer*. This allows students to work independently of the teacher, as the teacher does not hold the answers but rather she must be able to guide students through moments of frustration, uncertainty, and curiosity. In these instances, teachers partner with students in their learning; they ask students questions, push them to think beyond an obvious response, and prompt them to continue with their pursuit. Teaching in a makerspace and guiding students through these kinds of open-ended curricular experiences allows the students to be agents in their education and co-creators of knowledge.

One of the first projects Melissa assigned students to build which illustrates this pedagogical approach was *The Marshmallow Challenge.* She gave students very little instruction and a short window of time to create towers using uncooked spaghetti, tape, string, and a marshmallow. As students began to build their towers she could see that the structures would likely fall as soon as the children let go. Rather than intervening and pointing out these architectural flaws, she allowed students to continue building. When the allotted time passed, she yelled "hands-up" and, as she suspected, the majority of towers tumbled to the floor. For Melissa, the most important learning experience occurred at this moment. She gathered the students in a circle and asked them why the towers fell. Students analyzed their designs and reflected on the way that their towers fell. They compared the towers to structures they were familiar with, like the classroom walls and their own homes, and debated potential alternatives that would allow their towers to have more stability. As the students reflected on the failure of the first towers, their question to Principal Becker was,

"Do we get to try it again?"

Melissa's decision to teach in the makerspace allowed her to co-teach with colleagues and introduce the space as a unique and different learning environment. Expecting her colleagues who were not familiar with makerspaces to jump into the Maker Lab with the same enthusiasm and energy as she had would have been asking too much. Melissa knew that she needed to model how the space could provide different kinds of learning opportunities for students, and as she demonstrated how the Maker Lab functioned for both adults and students, her colleagues and parents were convinced of the space's potential to support authentic and innovative learning.

"The focus on maker culture is a natural extension of a long-standing emphasis on learning-by-doing in art and science."

–Erica Rosenfeld Halverson and Kimberly M. Sheridan, 2014

Another way Principal Becker created buy-in with her colleagues and parents was by demonstrating how their Maker Lab aligned with California's adoption of the Common Core State Standards (CCSS), Science, Technology, Engineering, and Math (STEM) and Next Generation Science Standards (NGSS).

These standards focus on the disciplinary principles and practices for core subject areas, including a targeted approach on depth and coherence of content and overall academic rigor in order to prepare students for career, college, and lifelong learning.[2]

The makerspace allowed Melissa to turn theory in action:

> *"One logical place for this new depth of learning to occur is through making because it is aligned with what we know works with students: students learn by doing and experiencing. They learn best when the stakes are not high and they can interact in a safe learning environment that is stimulating. A makerspace allows students to dive into sequenced obstacles that are presented in a meaningful context—one that is content-rich and student-centered. Additionally, the projects and tasks often allow students to engage in the practices of a discipline such as science or mathematics. This coupling of theory and learning with real- time understanding that is naturally differentiated fosters cooperative learning in a tangible way; students see the benefit of working as a team to problem solve."*

Meadow's Maker Lab is a unique setting that both exemplifies and fosters the concept of failure. In a regular classroom setting, adults do not often provide opportunities for students to fail in a safe setting. If students fail a test, for example, that is usually not touted as something positive. Through making, failure is an integral part of learning. Students can push through failure to reflect on one's experience and also watch peers as they engage in the experience. In this setting, students learn to glean ideas from one another, pushing for a prevailing design idea. That idea may fail, or may be successful, but what is important is that students can learn from either.

For instance, when delving into math there is often an expectation that there is a usually a right answer and a wrong answer. Math is viewed as concrete or absolute. The Maker Lab allows students to explore and see math in action, in real time with real applications. Students need to be able to justify why a particular mathematical statement is true or where a math rule comes from, not just simply solve a problem by memorization.

Recently, the Agency by Design initiative at Project Zero, a research organization at the Harvard Graduate School of Education, released a white paper titled, *Maker-Centered Learning and the Development of Self: Preliminary Findings of the Agency by Design Project* (2015). The authors highlight the importance of making and learning and remind educators to look beyond standards and skill sets in order to see the social and emotional benefits of making:

> *To focus on STEM skills and the like as the primary outcome of maker education would be to sadly miss the point—like saying that learning to cut your food with a knife and fork is the most important outcome of eating a nutritious meal. In contrast, what we have been hearing from maker practitioners on the ground is the power of maker-centered learning to help students develop a sense of personal agency, a sense of self-efficacy, and a sense of community (p.4).*

As educators, we have found that making engages students in meaningful, rigorous, and innovative learning experiences allowing students to dive deeply into core content and to become empowered learners.

What Success Looks Like in a K-5 Maker Lab

Meadow Elementary School students, Audrey and Lily, share their excitement as they create squishy circuits with conductive dough.

According to the *U.S. Department of Commerce Economics and Statistics Administration* (July 2011), over the past 10 years the growth in science, technology, engineering and mathematics (STEM) jobs was three times as fast as growth in non-STEM jobs. Additionally, more than two-thirds of current STEM workers have at least a college degree, compared to less than one-third of non-STEM workers. In their 2013 *The Condition of College Readiness* national report, the ACT found only 26 percent of 2013 tested graduates met all four ACT College Readiness Benchmarks.

IV. MAKING IN AFTER-SCHOOL SETTINGS: MAKER SUMMER CAMPS

"Tom Friedman argues in The World is Flat that all we really need to know to be successful in life is how to come up with an idea and execute on it. Children have the first part down--they are hardwired for creativity. The challenge is what comes next. That's what makerspaces teach kids: the confidence and the competence necessary to execute their creative vision."

— Parker Thomas, 2015

In addition to implementing makerspaces and maker activities in K-12 classrooms in Sonoma County, educators also introduced summer camps as a way of engaging students and the community in making. For Comstock Middle School and Schaefer Charter School, the introduction of Maker Camps served as a low barrier entry to explore making in an after-school setting.

Comstock Middle School: Project Make Program

The Comstock Middle School Project Make program was also created after the success of their 2013 and 2014 Maker Camps. Funded and supported by the Nancy C. and Dale Dougherty Foundation and the Boys & Girls Club of Central Sonoma County, the camp also partnered directly with Santa Rosa City Schools. In 2014, Comstock's Project Make program was recognized by Sonoma State University with the Jack London Award for Educational Innovation and received a CSBA Golden Bell Award in the area of Curriculum/Other Content.

Teachers John Lundblad and Dawn Thomas spearheaded the Project Make program, providing a rich making environment, including access to diverse tools and materials from which students developed and applied academic, aesthetic, technical and interpersonal skills by creating and building meaningful products appropriate to the middle school level.

Photo Courtesy Make: Magazine, Comstock Maker Camp (2013)

Dawn Thomas, an art teacher and maker herself who is actively involved in maker activities and the Bay Area Maker Faire, noted that Comstock Middle School's Project Make was originally created as an elective after the school hosted a very successful free Summer Maker Camp. The school was looking for a way to integrate Art with STEM curriculum, to create more hands-on opportunities to learn and to apply that knowledge, especially with many of their English Language Learners.

In reflection of her students' experiences with Comstock's Maker Camp and Project Make Dawn says,

> *"When given the chance, students will self-select into co-operative learning teams with clearly defined, yet evolving roles. The teams naturally work together to problem-solve and to meet challenges, all within an undefined set of parameters. It is amazing to watch, even when there is bickering, and it demonstrates an innate, group human intelligence that gives me a lot of hope for our future on the planet."*

Schaefer Charter School: Gina Silveira

Gina Silveira, Principal of Schaefer Charter School in Santa Rosa, California with the support of Jennie Snyder, Superintendent of the Piner-Olivet Union School District (POUSD), shared her experiences about offering a district-wide Maker camp in the summer of 2014.

> *"I wanted to have a Maker Camp for several reasons. First, I felt it would be a huge first step in infusing maker education into the elementary school setting. For so long I had heard that maker ed is mainly for middle and high school students. In fact, I went on a makerspace tour and only saw middle and high school examples,*

> *aside from Meadow elementary school's example where Melissa Becker ran the maker education activities herself. One of the guides on our tour remarked that maker education isn't really considered an elementary thing. This bothered me, and I decided to take on the challenge of changing that perspective. Thus, the POUSD grades 2-6 Maker Camp was born.*

> *"Second, I wanted to have a Maker Camp because I believed it would help teachers see the value in maker education and help with my goal of creating a makerspace on our campus. By nature, teachers have a difficult time stepping back and letting students own their learning. Maker education forces teachers to do just that. My most remarkable take-away from our Maker Camp experience was watching the five teachers who worked in the camp begin the first day scared, nervous to allow students to have so much control of their learning, worried about not having a lesson plan to work from, and watching these same teachers transform into 'maker-converts'. By the end of the camp, all of the teachers stepped back, allowed students to fail and learn from their failures, watched students persevere, guided students rather than showed them answers, and realized the amazing opportunities maker education can provide for all students. Then, their growing interest in maker education translated into them telling their colleagues all about their experiences and peaking their colleagues' interest in maker education. Consequently, our Schaefer makerspace was created without a question as to why.*
>
> *"Third, I wanted students to love school and look forward to returning once summer ended. Because maker education provides students with engaging activities, students are excited to learn. I can't count the number of times I heard students asking, 'What is our next activity?' and saying,*
>
> ***'This is so fun! I can't wait for tomorrow!'***

"We held our camp a few weeks before school started, and at the end of the camp, students didn't want it to end. One student who had been in trouble a lot the prior year for behavior said that he couldn't wait for school to start. This year, he hasn't been sent to the office once. That's something.

Piner-Oliver's documentary highlights their Maker Camp during the summer of 2014.

"Finally, I wanted to prove that students are capable of anything. I think as teachers, we talk a good game about believing that, but with maker education, you really have to step back and put your money where your mouth is. We gave students saws, hammers and drills to use. We handed them scissors and duct tape and said, 'have at it'. We got out of the way, and we let the magic happen, and happen it did. Our students made amazing things. Our students believed in themselves. They believed in each other. They worked together; they persevered alone. They made things, and they loved learning along the way."

Gina credits Schaefer's second grade teacher, Will Hart, as the brains behind the design of the two week maker camp, which included activities such as: Lego engineering, simple circuits, the exploration of simple machines with pencils and string, and Gina Silveira's favorite – duct tape day, which included a wearable tech fashion show in which kids modeled their duct tape creations.

The success of the camp ultimately led to the development of the Schaefer makerspace during the subsequent school year. and demonstrated that maker education is definitely for K-5 students. Plans are already in the works for the 2015 POUSD Maker Camp.

These two maker camps highlight the bottoms-up approach to change that allows making to rapidly expand in our local schools. The partnerships formed, collaboration, and willingness of teachers and students to take risks by implementing making activities also model the core values and the maker empowerment we desire for our K-12 students.

V. MAKING AT THE COUNTY OFFICE OF EDUCATION

The *Sonoma County Office of Education (SCOE)* provides professional development to 40 school districts with 181 schools serving 70,000 students across Sonoma County. Because of its broad reach, SCOE has spurred the success and growth of maker education among local educators and school districts in the county. The SCOE team, led by Mickey Porter, Deputy Superintendent of Instructional Services, and supported by Dr. Steven Herrington, County Superintendent of Schools, views making as a powerful means to motivate and engage students in rigorous problem-solving and critical thinking. Students need to master new standards, and making provides a model for a 21st century learning environment which prepares students for college and career choices in the new economy.

SCOE's theory of action is to invest in teachers and administrators who then take what they have learned and their enthusiasm for making back to their schools for implementation. With the goal of using the potential of making to actively engage educators as reflective learners and creators, SCOE hired Casey Shea as a "maker-educator-on-loan" two days per week to provide hands-on workshops, on-site trainings, guidance for creating makerspaces, and resources for maker projects to get educators started.

Make and Take Workshops

Under the guidance of Casey Shea, SCOE piloted three *Make and Take Workshops* as part of their 21st Century initiative. The workshop activities included building an air-rocket launcher, wind tunnels, and marble machines. These do-it-yourself workshops were designed to engage teachers in the process of making through the use of low-barrier of entry materials and tools in an "it's okay to fail" learning environment. Guided by their maker mentor, Casey Shea, educators were able to participate alongside their colleagues and reflect on how their own students might benefit from maker activities. The activities and instructions were posted to the SCOE website along with curricular connections such as force and motion

and volume and surface area. In early June 2015, SCOE hosted a 4-day maker institute for teachers with follow-up that explicitly shows how making and maker education aligns with CCSS and NGSS and the development of 21st century skills.

As a result of the maker educator professional development opportunities provided by SCOE, approximately 150 Sonoma County teachers are implementing maker practices in their classrooms. There are six high schools, four middle schools and seven elementary schools where multiple teachers and grade levels have integrated making into the curriculum. Making classroom activities are available for students beginning as early as kindergarten.

Imagination Chapters

In June of 2014, the second annual *ieSonoma* symposium was held. The closing keynote speaker for the event was Nirvan Mullick, the filmmaker behind Caine's Arcade and the founder of the Imagination Foundation, whose mission "is to find, foster, and fund creativity and entrepreneurship in children around the world to raise a new generation of innovators and problem solvers who have the tools they need to build the world they imagine."

In planning for his appearance at ieSonoma, Nirvan Mullick learned of the extensive maker efforts underway in Sonoma County. This prompted him to invite Sonoma County to participate as a host site to pilot two of the thirty Imagination Chapters that would be a part of the Foundation's global pilot program. Thanks to the sponsorship provided by private donors and the fundraising efforts of parents and community members, Sonoma Country Day School and Schaefer Charter School were selected as the host sites. The participation of the two schools gave students in grades K-2 a chance to regularly engage in creative play to develop their natural powers of creativity, entrepreneurship, and innovation.

Gina Silveira, Principal of Schaefer Charter School, describes the impact of creative play on K-2 Graders:

"When we were chosen to be one of the Sonoma County Imagination Foundation Chapters, we were elated! We began the year with the assumption that creative play and Maker education were two separate things, on parallel planes. However, as the year progressed, it became clear that creative play is more like a catalyst for maker education rather than something running parallel to it.

"It was during our Maker Camp that we realized several students had not had the opportunity to work with various tools, and they needed time to play with the materials. This opportunity to play became much more than simply exploring specific tools and materials. The students blossomed as they followed their desires, playing at their own pace, and demonstrating independence and an ability to team up to share their insights. Creative play was an essential aspect of their maker experience.

"When we were chosen to be an Imagination Foundation Chapter, we wanted to extend the playful experience we witnessed during Maker Camp. We picked one of our second grade classes to be the cohort of students who would participate in the Imagination Club. Because the teacher in charge of the second grade cohort of students was a first year teacher, she worked closely with her support provider, a Kindergarten teacher, and his students. A very unique bond formed between his students and hers, and her second graders became mentors to the Kindergarten students who also participated in the Imagination Club every Friday afternoon.

"From there, we observed students bonding with one another cross-grade level outside of the Imagination Club. We saw students offering advice to one another (on both ends - K to second graders and second graders to K students) during construction time. We witnessed a level of ownership and pride in the materials the students were fortunate to engage with during the Imagination Club. Most importantly, we saw students who normally were shy and didn't behave as leaders shine and break out of their comfort zone during the creative play periods. The teacher remarked that she couldn't believe that certain students were able to do what they were able to do, and she strongly believed it was due to their Imagination Club experiences."

Participation in the Imagination Chapter pilot program allowed these two Sonoma County schools to play a role in research on creativity and the design of new measures to assess entrepreneurial thinking in children.

Curriculum and Instruction Steering Committee (CISC)

In 2014, SCOE was selected for the honor of coordinating the 2015 *Curriculum and Instruction Steering Committee (CISC) Leadership Symposium*. CISC is a committee of the California County Superintendents Educational Services Association (CCSESA). The annual CISC Leadership Symposium brings together over 1,000 educational leaders from throughout California for three days of networking and learning about the latest shifts in education and models of innovative action. Each year, a different County Office of Education is selected to coordinate the Symposium.

Following on the heels of the excitement and theme of the Imagination Chapters, the 2015 symposium was titled, *What If? Imagining Education for the 21st Century.* Dan Blake, Director of Innovation & Partnerships at SCOE, was one of the individuals charged with the coordination of the symposium. In his summation of SCOE leadership's planning and direction of the event, he reflects:

> *"Historically CISC has been a more traditional conference, focused on the current trends, policies and issues in California. The theme for the 2015 Symposium was: "What If...? Leading with Imagination," so including and emphasizing the Maker Movement in the offerings was an easy choice.*
>
> *"In planning the theme and strands for the event, SCOE leadership put a major emphasis on sharing the successes associated with the Maker Movement in local schools and districts. Since the Maker Movement is about "making" and "doing," we wanted to be sure to not only tell people about these successes, but to provide them with opportunities to experience the power of the Maker Movement first-hand. To accomplish this, we set-up an area called the Imagination Space that featured demonstrations of some of the latest high-tech and low-tech equipment being used in school Makerspaces, including: a 3D printer; a CNC pen plotter; a laser cutter/engraver; robotics; a vinyl cutter, a wind tube, and a number of student project examples. Teachers from three Bay Area schools staffed the Imagination Space and provided attendees with opportunities to see and experiment with equipment many had previously only read or heard about.*
>
> *We also provided a full complement of sessions highlighting the Maker Movement. Dale Dougherty, CEO of Maker Media, Inc., served as a keynote speaker on the second day of the event, and Nirvan Mullick, the filmmaker who created the short film Caine's Arcade and later founded the Imagination Foundation, and Caine Monroy, the subject of the now famous film, were our closing keynote speakers. Since the Symposium is primarily attended by school and district administrators, we assembled a panel to discuss the specific role of school leaders in the Maker Movement.*
>
> *For those attendees deeply interested in rolling up their sleeves and making, we offered a two-hour workshop during which one of five projects could be completed. This was followed by a discussion on how each of the projects connects to the new Common Core State Standards, Next Generation Science Standards, and critical 21st century skills. Two other sessions focused on redesigning classrooms, computer labs, or other school spaces to support the Maker Movement. Finally, a 15-minute quick talk provided attendees with information about the newly-developed Maker Educator Certificate Program.*

"By providing such a comprehensive list of options for attendees to not only learn about but experience the power of the Maker Movement, it was our hope that these educational leaders would return to their respective schools and districts full of energy and begin putting their newfound ideas into practice.

"Based on the following excerpts from the Symposium evaluations, as well as the follow-up calls and emails we've received soliciting additional information about the Maker Movement in education, we can safely say that we accomplished our goal:

- *"What if the Symposium could always be this innovative and forward thinking?"*
- *"What if my district could cultivate the commitment to creativity and innovation captured during CISC 2015?"*
- *"What if my school set up a creation station maker room for kids to explore, create, and learn?"*
- *"What if I could get others on board the Maker Movement?"*
- *"What if I could take the Maker Movement and share it with all stakeholders and support a learning community?"*
- *"What if I could make a difference right now with maker spaces?"*
- *"What if I could redesign my work space to reflect new working and learning dynamics?"*
- *"What if I worked with my school sites to implement a maker academy this summer?"*

The overwhelming success of the CISC symposium has led to increased interest and communication from educators through California about the Maker Movement, including a participant from Southern California who traveled nine hours to complete the Maker Educator Certificate program.

Makerspaces in Sonoma County

Prompted by the momentum of the Maker Movement in local education, SCOE was approached in December of 2014 by a local developer about partnering to develop a large community makerspace in Sonoma County. Following a series of discussions and planning meetings that included representatives from the County Board of Supervisors, the Sonoma County Economic Development Board, Sonoma State University, Santa Rosa Junior College, the City of Santa Rosa, the North Bay Leadership Council, and multiple local employers, a decision was made to move forward on converting a 16,000 square foot warehouse on the south end of Santa Rosa into a makerspace that will impact not only the education community, but will serve as a critical resource for workforce development efforts, entrepreneurial startups, and cross-generational mentoring.

A seven-member board has been formed, consisting of the following individuals: Alon Adani, Cornerstone Properties; Dan Blake, SCOE; Kevin Crandall, The Daymen Group; Tom Fetter, Keysight Technologies; Sandy Litzie, retired community member; Jessica Parker, SSU; and Bob Whitlock, Small Precision Tools. Articles of Incorporation have been filed with the State and we are currently in the process of obtaining our nonprofit status under the name North Bay Makers. The space is scheduled to open in the fall of 2015.

The Sonoma County Office of Education's Design Lab, opening in June 2015, is both a model for schools to see how they might repurpose an existing area into a 21st century learning environment focused around making, collaborating, innovating, and creating and a fully functioning makerspace and multimedia lab. It will be used by educators and students for professional learning workshops in all content areas grades K-12. The Design Lab is also a physical reminder of SCOE's commitment to maker education and 21st century teaching and learning.

VI. MAKER EDUCATOR CERTIFICATE PROGRAM AT SONOMA STATE UNIVERSITY

First Maker Certificate Cohort, April 2015

Sonoma State University (SSU) is one of 23 campuses in the California State University (CSU) system. Considered a mid-sized CSU campus with approximately 9200 students, SSU has long been committed to graduating students who have the ability to think critically and ethically, can effectively use technology, and prepare students for the needs of the 21st century workplace. Under the guidance of Dean Carlos Ayala, SSU's School of Education prepares 200 teachers each year to work in California schools.

In 2013, making became a central component of the School of Education's 3rd Annual Teacher Technology Showcase. With Sonoma County Office of Education as an event partner, Dr. Jessica Parker, Associate Professor and Chair of the School of Education's Department of Curriculum Studies and Secondary Education, designed the Showcase to have a makerspace run by local maker educators and Sonoma State University alumni, Julia Marrero, Kaki McLachlan, and Mary-Clare Neal. The educators guided attendees, both young and old, with the programming of Makey Makey, the creation of buttons and other wearables, and the designing of Blinkybugs.

With new standards and changing expectations for teachers and students, The Startup Classroom provides SSU and the School of Education with an innovative arm to promote promising new practices and approaches for teaching and learning, including The Maker Certificate Program.

The Startup Classroom emerged from a groundbreaking dialog between the Sonoma State School of Education and School of Business and Economics. Both sides learned from the other as they explored the key ideas, mindsets, and models that maximize creativity and resourcefulness for both educators and entrepreneurs. One of the main tenets of The Startup Classroom is that educators don't need to be fixed...they need to be empowered.

As maker camps and makerspaces became more prevalent in Sonoma County, Jessica Parker identified the need to provide maker professional development opportunities for educators. The Startup Classroom and its focus on empowerment set the stage for Jessica and her collaborators to develop a Maker Certificate Program:

"The development of the Maker Certificate Program began serendipitously. Dan Blake, Director of Innovation & Partnerships at Sonoma County Office of Education, and I had been discussing in passing how to support educators with maker education and, by accident, we found ourselves at the same maker event – MakerCon in Redwood City in May 2014. We sat down during a break and realized that a Maker Certificate Program was needed in the Bay Area – it was something that so many educators were interested in, there were so many great maker events in the area, and there were amazing maker educators who were doing wonderful, student-centered, inquiry-based work. We wanted to be able to connect the dots for educators and offer a way for them to come together, learn from one another, and get recognition and support for maker education. During that lunch break, Dan and I sat with two of his colleagues and sketched out an outline of our ideas. By summer, we had a rough draft."

With a draft proposal in hand, Jessica, Dean Ayala, and Dan Blake met with Dale Dougherty to nurture a partnership based on supporting educators, including pre- and in-service teachers, in maker education. These initial conversations and subsequent discussions with local maker educators assisted in developing a Maker Certificate Program that was grounded in both hands-on making and connected to core values and learning and design principles of making. Adapting key *Connected Learning* principles from *The Digital Media & Learning Research Hub* to a professional development model for educators, the core values of the program highlight a focus on equity, social connection, full participation, and stewardship and sustainability. Additionally, the learning and design principles of the program center on peer-based communities that foster deep participatory learning and are production centered and openly networked. The final proposal was approved by Sonoma State University in early fall of 2014, and offered educators a relatively low-cost program based on completing 50-seat hours (5 continuing education units) to become Maker Certified.

Core Values	Learning Principles	Design Principles
• Equity • Social connection • Full participation • Stewardship & Sustainabilty	• Peer supported • Interest powered • Deep participatory learning • Interdisciplinary • Learning as lifelong	• Production centered • Openly networked • Shared purpose • 21st Century Learning: rethinking risk, failing forward, experimenting, iterating, relevancy

Figure 2: Core Values and Principles of the Maker Certificate Program, adapted from the *Connected Learning Movement*

Using initial funding from Dale Dougherty and The Startup Classroom, supplemented by course design funds from the School of Extended and International Education at SSU, Jessica recruited local maker educators to develop the mini-courses: Casey Shea from SCOE, and White Hill Middle School teachers Kaki McLachlan and Julia Marrero, both graduates of Sonoma States Master's in Education degree program and their fellow teacher Nate MacDonald.

Kaki, Julia, and Nate, helped to form what has become known as White Hill Middle School's "STEAM Team." Through innovation and a passion for teaching Science, Technology, Engineering, Art, and Mathematics (STEAM) concepts and introducing technology into the classroom to support 21st century learning skills, the trio helped to form an elective technology and engineering program at White Hill. Currently, 241 students participate in the program and 252 sixth graders gain an introduction to the elective courses during designated technology time in their class schedules. The elective classes include an Inventors Lab, Digital Media, Engineering Design, and Makers & Hackers. Their students work with 3D printers, EV3 robots, circuitry and more in engaging projects that exemplify engineering and digital media concepts.

One of the strengths of the Maker Certificate Program is that maker educators such as Kaki, Julia, Nate, and Casey have designed the two main courses at the heart of the program: Making for Educators and Introduction to Making.

The first course, *Making for Educators*, launched in October 2014, with Casey Shea and Nate MacDonald as co-facilitators:

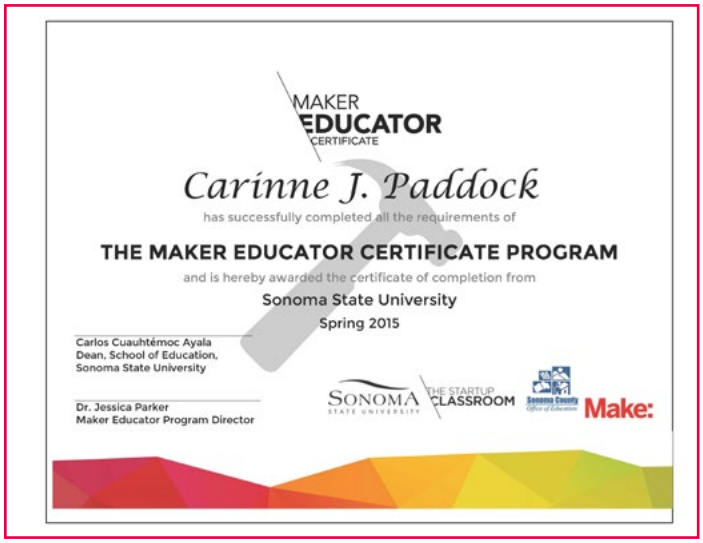
> Making for Educators combines four hands-on making sessions at different K-12 makerspaces with tools and resources for developing one's own maker identity. Participants engage in sustainable maker activities as they build a personal learning network (PLN) of maker educators and analyze how to support and fund making activities. Participants create their own maker portfolio in order to document their ongoing maker experiences and reflect on maker-related activities, tools, and resources. 20 hours of instruction for 2 CEUs.

The second course, *Introduction to Making*, an online course, launched in November 2014, with Julia Marrero and Kaki McLachlan as co-facilitators:

> Introduction to Making is a four-session online course that introduces participants to the history of making in the United States, and the philosophy and mindset of making through interactive activities and making experiences. Participants examine their own learning environments, be it a classroom environment, library hang out space, community center, or after-school Fab Lab, to determine how to best create a space that promotes a culture of making and sharing. Participants engage in reflective conversations with one another and the instructors as to how making aligns with educational initiatives such as Common Core standards and the Next Generation Science Standards. Participants develop a targeted action plan for implementing maker activities in a learning environment. 20 hours of instruction for 2 CEUs.

In addition to bringing in local educators, the Maker Certificate can be applied to organizations already providing professional development opportunities for maker education. Current organizations include the Sonoma County Office of Education, *NexMap*, the *Creativity Lab* in Oakland, and *MakerEd* and its *Maker Corps Program.*

Since October 2014, over 40 educators have entered the Maker Certificate Program and taken at least one course. Twenty educators have earned Maker Certification. Eighty percent of the participants have been K-12 in-service teachers (69%: K-8 teachers and 31%: 9-12th grade teachers), 10% pre-service teachers, and 10% administrators. Upon certification, educators are invited to teach and develop courses in the program. By developing a peer network of maker educators, the Maker Certificate Program attempts to support educators with the development of a maker mindset and provide a foundation for designing and implementing making projects and activities throughout their curriculum.


MAKER EDUCATOR CERTIFICATE

Carinne J. Paddock

has successfully completed all the requirements of

THE MAKER EDUCATOR CERTIFICATE PROGRAM

and is hereby awarded the certificate of completion from

Sonoma State University

Spring 2015

Carlos Cuauhtémoc Ayala
Dean, School of Education,
Sonoma State University

Dr. Jessica Parker
Maker Educator Program Director

SONOMA STATE UNIVERSITY · THE STARTUP CLASSROOM · Sonoma County Office of Education · Make:

Learn more about the Maker Certificate program, course offerings, and Maker Faculty

www.thestartupclassroom.org

VII. LESSONS LEARNED: REFLECTIONS ON THE GROWTH OF MAKER EDUCATION IN SONOMA

Bringing the maker movement into the education conversation has the potential to transform how we understand 'what counts' as learning, as a learner, and as a learning environment.
— Erica Rosenfeld Halverson and Kimberly M. Sheridan, 2014

This case study highlights the growth of Sonoma County's maker educator network by identifying key stakeholders and pivotal moments of opportunity and partnership. Through radical collaboration and a bias towards action, we have been able to rapidly expand making in our local educational settings. The successful development and growth of the maker movement in our county has been based on a number of factors (that may or may not be applicable to other educational communities), including:

- True collaboration among different organizations: Our collaboration with like-minded partners who share common goals is truly inspiring. The Maker Movement isn't about tools and gadgets; it's about people engaging in activities that they love and sharing their love of learning with others.

- Focusing on the needs of K-12 learners: Our common belief that learning should be student-centered and meet the needs of all learners enabled us to create rich making opportunities in our K-12 schools settings.

- Investing in a small number of educators who were interested in making and willing to share their enthusiasm and know-how.

- Organically growing the maker educator network (e.g., bottom-up movement) in which we asked administrators to support and nurture, not takeover (e.g., top-down effort): There is not a "one size fits all" approach to making. Educators integrated making at their sites in ways that worked for their learners and their community, which allowed our network to expand organically and will, hopefully, be sustainable.

- Understanding that making is deeply personal: We invite educators who are interested in integrating making in education to reflect on their own maker core values. The goal should not be to fit making into school-based learning; the goal should be to reframe and redefine schooling to allow making, and our students, to flourish.

- Allowing time to learn, grow, and share: If we had treated making as a fad, then it would have become just that. We thought about change via making on a number levels: pedagogical, curricular, organizational, and material; this required buy-in and conversations with administrators, parents, and other stakeholders. Making should not be another thing to add to an educator's plate; rather, making invites a cultural and curricular shift within schooling and requires the time to develop a rationale for why making matters at a given site.

- The most underutilized resource in a school are its students. We relied on them as barometers for feedback and insight.

VIII. INFLUENCERS AND RESOURCES

An essential aspect of making and being part of a maker community is the documentation and sharing of resources, insights, epiphanies, and epic fails. We have gathered the materials that have influenced our community and have offered some of our own work to share.

1 "No Excuse for Not Reading!" Materials

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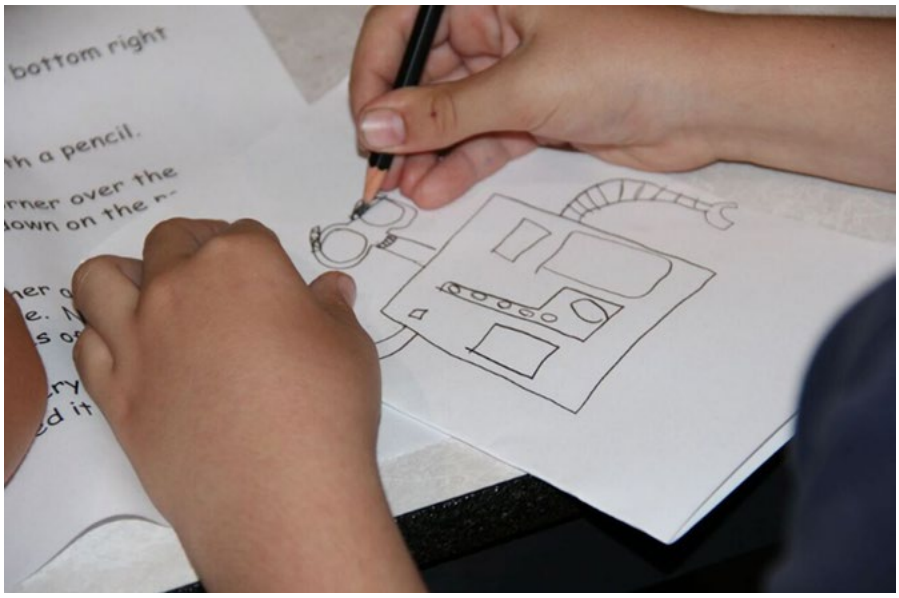
Awesome Maker Educator Organizations & Communities

- 21st Century Notebooking: https://plus.google.com/u/0/communities/106297899247135466221
- Agency by Design: http://www.agencybydesign.org/
- Autodesk's Project Ignite: https://projectignite.autodesk.com/
- Connected Learning Alliance: clalliance.org/why-connected-learning/
- Constructing Modern Knowledge Summer Institute: http://constructingmodernknowledge.com/cmk08/
- Design Thinking for Educators: http://www.designthinkingforeducators.com/
- DML Research Hub: http://dmlhub.net/
- d.school's K12 Lab Network: http://www.k12lab.org/
- Educator Innovator: http://educatorinnovator.org
- Edutopia Maker Education resource page: http://www.edutopia.org/topic/maker-education
- Global Cardboard Challenge: http://imagination.is/our-projects/cardboard-challenge/
- Imagination Foundation: http://imagination.is/
- Integrated Learning Specialist Program from the Alameda County Office of Education: http://www.artiseducation.org/what-we-do/our-programs/integrated-learning-specialist-program
- #InventAnything with littleBits and P2PU: http://info.p2pu.org/2015/02/06/inventanything-with-littlebits-p2pu/
- K-12 Fab Labs and Makerspaces https://groups.google.com/forum/#!forum/k-12-fablabs
- Learning and Facilitation Frameworks from The Tinkering Studio at the Exploratorium: http://tinkering.exploratorium.edu/learning-and-facilitation-frameworks
- Maker Certificate Program at Sonoma State University: www.thestartupclassroom.org/maker-course/
- Maker Education Initative Community: https://plus.google.com/u/0/communities/108516741770696736815
- Maker Faire: http://makerfaire.com/
- Making Learning Connected MOOC: https://plus.google.com/communities/111619469354411254407
- NexMap: http://www.nexmap.org/21c-notebooking-io/
- Remaking Learning Network: http://remakelearning.org/
- Tinkering Fundamentals: A Constructionist Approach to STEM Learning: https://www.coursera.org/course/tinkering

3 Makerspaces We Love

- Castilleja Bourn Idea Lab (Palo Alto, CA): http://www.castilleja.org/page.cfm?p=941600
- Chimera (Sebastopol, CA): http://chimeraarts.org/
- Creativity Lab at Lighthouse Community Charter School (Oakland, CA): http://lighthousecreativitylab.org/
- Digital Harbor Foundation (Baltimore, MD): http://www.digitalharbor.org/
- East Bay School for Boys (Berkeley, CA): http://eastbayschoolforboys.tumblr.com/
- Innovation and Creative Lab at Lane Technical College Prep High (Chicago, IL): http://www.lanetech.org/makers-lab.php
- Lick-Wilmerding High School Technical Arts Department (San Francisco, CA): http://www.lwhs.org/Page/Curriculum/Departments/Technical-Arts
- MAKESHOP at the Children's Museum of Pittsburgh (PA): http://makeshoppgh.com/
- Project Make (Sebastopol, CA): http://www.projectmake.org/
- SparkTruck (Palo Alto, CA): http://sparktruck.org/
- TechShop (San Francisco, CA): http://www.techshop.ws/
- The Crucible (Oakland, CA): http://thecrucible.org/
- The NYC Makery (Somewhere, NYC): http://www.nycmakery.com/
- The Tinkering Studio at the Exploratorium (San Francisco, CA): http://tinkering.exploratorium.edu/

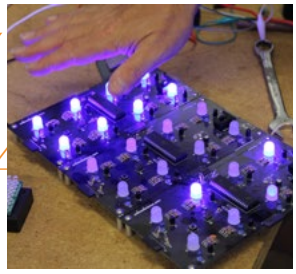


4 Videos that Rock

- Annmarie Thomas, Hands-on Science with Squishy CIrcuits: http://www.ted.com/talks/annmarie_thomas_squishy_circuits?language=en
- Caine's Arcade: http://cainesarcade.com/
- Dale Dougherty, We Are Makers: http://www.ted.com/talks/dale_dougherty_we_are_makers
- Educator Innovator's Making in K-12 Settings (Part I) webinar: http://educatorinnovator.org/webinars/making-in-k12-settings-part-1/
- Educator Innovator's Making in K-12 Settings (Part 2) webinar: http://educatorinnovatororg/webinars/making-in-k12-settings-part-2/
- Educator Innovator's Maker Education: What is Design? webinar: http://educatorinnovator.org/webinars/maker-education-part-1-what-is-design
- Educator Innovator's Learning By Making: An Introduction to Constructionism webinar: http://educatorinnovator.org/webinars/learning-by-making-an-introduction-to-constructionism/
- Emily Pilloton, Teaching Design for Change: http://www.ted.com/talks/emily_pilloton_teaching_design_for_change?language=en
- Jen Ryan, The Maker Mind: https://www.youtube.com/watch?v=cI2cMyOZVgE
- Karen Wilkinson, Making, Tinkering, and Design: https://vimeo.com/110200853
- Leah Buechley, How to "Sketch" with Electronics: http://www.ted.com/talks/leah_buechley_how_to_sketch_with_electronics
- Maker Education Inititative's YouTube Channel: https://www.youtube.com/user/MakerEdInitiative
- Maker Educator Certificate Program at The Startup Classroom YouTube Channel https://www.youtube.com/user/StartupClassroom/feed
- Piner-Olivet Union School District (POUSD) Maker Camp: https://www.youtube.com/watch?v=lxxgvv__pUo&feature=youtu.be
- Sir Ken Robinson, Do Schools Kill Creativity: http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity?language=en
- Sonoma State University Global Cardboard Challenge, It Takes A Village to Make a Village: https://www.youtube.com/watch?v=1jEi1enX5io
- SparkTruck Movie: http://sparktruck.org/movie
- Sylvia's Super-Awesome Maker Show!: http://sylviashow.com/

5 "Where to Start?" Resources for Educators, Facilitators, and Parents

Tips from our Educators in K-12 Makerspaces



- Carinne Paddock's Maker Portfolio: https://sites.google.com/a/lasdk8.org/adventures-in-room-15/maker-portfolio
- Gary Jordan's Maker Portfolio: http://gjordan0.wix.com/maker-portfolio
- Julia Marrero's Math Matters website: http://mathmarrero2015.weebly.com/
- Kentfield School's Making in the Classroom webpage: http://bit.ly/1EJfayT
- Kenwood Elementary School Maker's website: http://kenwoodmakers.weebly.com/projects.html
- Melissa Kang's Maker Portofolio: http://www.makingitmaker.com/
- Project Make: http://www.projectmake.org/
- Susan Donner's Building a Maker Enrichment Program for Middle School blog post: http://www.thestartupclassroom.org/blog/2015/3/23/7qyqilxpvbfzjqc59497334esex0j2
- White Hill Middle School's Robotics website: http://whitehillrobotics.com/

Sites for Projects, Ideas, and Inspiration

- Community Science Workshop Network Project's Page: http://www.cswnetwork.org/projects/survey.php
- Invent to Learn website: http://www.inventtolearn.com/
- Interconnections: Understanding Systems through Digital Design (2014) series: http://digitalis.nwp.org/gnl and related SparkFun kits: https://www.sparkfun.com/interconnections
- Jessica Parker's blog: http://teachingtechsavvykids.com/
- Kami Thordarson's website: http://www.kamithordarson.com/read-me/
- Make and Take workshops at SCOE: http://www.scoe.org/pub/htdocs/blog-make.html?id=159
- Sonoma County Office of Education Maker Education Resources: http://www.scoe.org/pub/htdocs/21c-maker.html
- The Startup Classroom Blog: http://www.thestartupclassroom.org/blog/
- The Tinkering Studio's Featured Projects webpage: http://tinkering.exploratorium.edu/projects
- Thomas, P. (2015). 6 Things to consider before starting your makerspace: https://www.edsurge.com/n/2014-10-10-6-things-to-consider-before-starting-your-makerspace

MAKER CERTIFIED

SONOMA STATE UNIVERSITY

THE STARTUP CLASSROOM

MAKER EDUCATOR CERTIFICATE

Make:

Sonoma County Office of Education