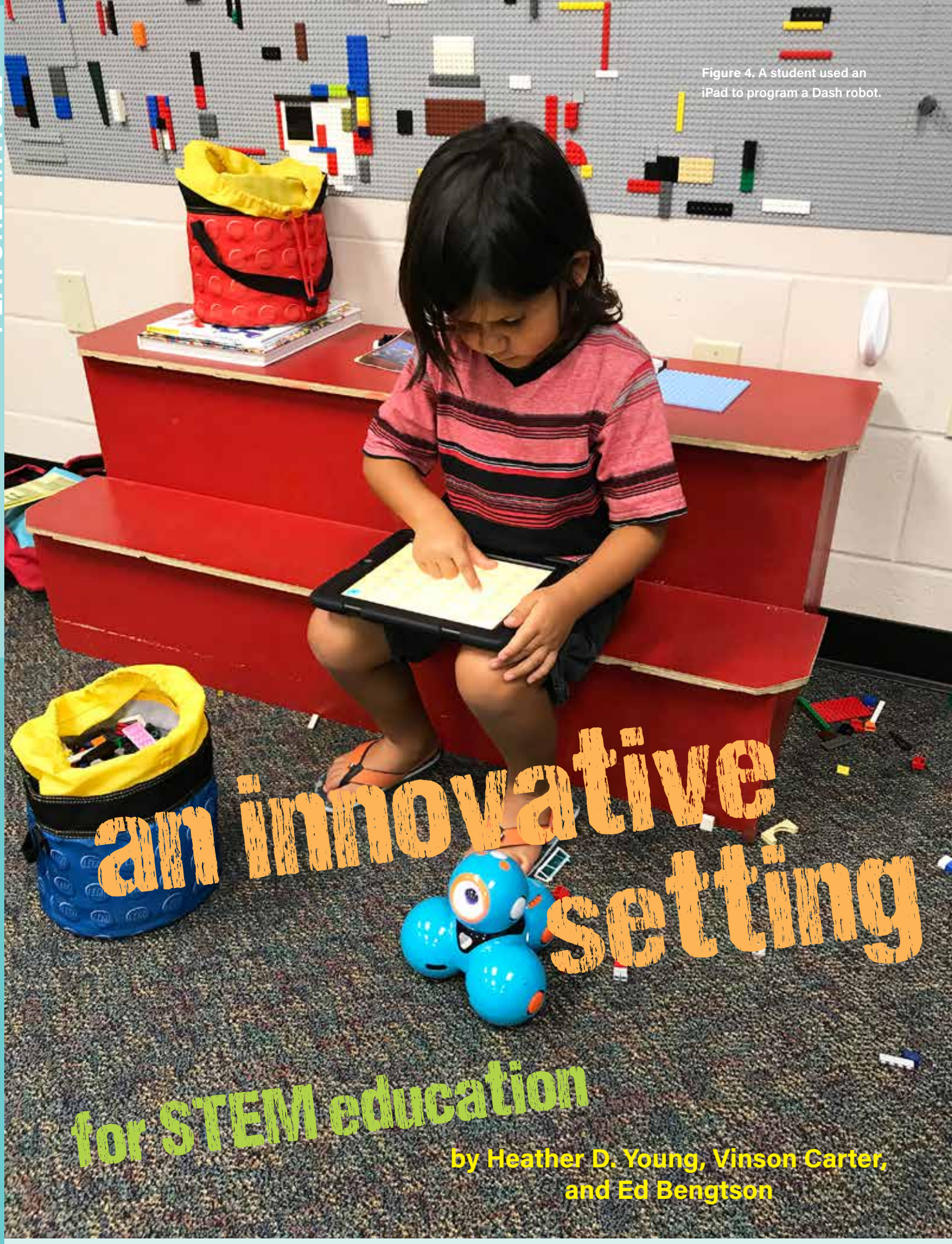

Figure 4. A student used an iPad to program a Dash robot.

an innovative setting for STEM education

by Heather D. Young, Vinson Carter, and Ed Bengtson

> In the current landscape of STEM education, community makerspaces and tinkering labs can be found in local libraries and public spaces (Moorefield-Lang, 2015).

Following these trends, many K-12 schools have implemented library makerspaces. "Makerspaces are the perfect partnership for libraries—where information is stored, accessed, shared, explored and wondered over" (Daley & Child, 2015, p. 43).

The faculty and staff at Willis D. Shaw Elementary in Springdale, Arkansas have taken these ideas to create their own vision for STEAM education in the school's Wonder Lab. The mission of the Wonder Lab is to provide students with opportunities to explore, create, and to apply their learning through design challenges and standards-based play activities. The teachers at Shaw Elementary believe that a child's natural curiosity is sparked when they are given the freedom to wonder and inquire. Their hope is that those sparks will ignite a passion for learning, and ultimately create confident, self-directed, innovative problem solvers.

the evolution of the Wonder Lab

The past five years have been an amazing journey for Kim Gadberry and Julie Herrera, the key players in this story. Kim, the librarian, and Julie, the technology manager, have taken an obsolete computer lab and developed an innovative, creative, student-centered space known as the Wonder Lab. The Wonder Lab is a place for all students to explore science, technology, engineering, art, and mathematics (STEAM) concepts.

Kim Gadberry has been an educator for 30 years. She spent her first seven years in the classroom, has worked as a literacy coach, and has worked at two different schools as the librarian. She has been the librarian at Shaw Elementary since the school opened in 2007. Kim has worked with Julie Herrera for over 20 years. Kim describes Julie as very creative, hard-working, and passionate.

Figure 1. Students typically complete two or more projects during their hour in the Wonder Lab, including engineering design challenges and exploratory activities that involve making and tinkering.

Julie Herrera began working as an instructional aide in 1998 when her youngest son entered kindergarten. She quickly moved into managing the school's computer lab, working with both students and teachers. During this time, she worked in close collaboration with Kim. When Shaw Elementary opened its doors in 2007, Julie moved along with Kim, and they continued their partnership.

The Wonder Lab has been a work in progress for five years. The original idea was conceived out of the makerspace movement in school libraries and has since evolved into a standards-based STEAM learning experience for students in K-5. When one-to-one technology made its way to the Springdale School District, Kim and Julie realized their opportunity to create something new and dynamic for the students at Shaw Elementary. They cleaned out the no-longer-needed computer lab and turned the space into the newly branded Wonder Lab.

building a community of practice

What emerged from design challenges found on Pinterest and Facebook has transitioned to standards-based instruction led by a dedicated team. Kim and Julie work with teachers to identify the scope and sequence of classroom learning in order to align experiences for students in the Wonder Lab. The administration at Shaw Elementary attributes most of the success of the Wonder Lab to Kim and Julie's caring, determination, and work ethic; however, they are quick to mention that the school community or culture has also given this initiative the boost needed to develop the program.

The Scott Family Amazeum has also been instrumental in professional development experiences, providing a venue that fosters a collaborative community of innovative teaching practice. The Amazeum is a local museum that provides visitors with hands-on experiences and chances to inquire, invent, and marvel. Comprised

of both indoor and outdoor spaces, the Amazeum includes a tinkering laboratory, interactive STEAM exhibits, and opportunities for the community to play and explore in an informal learning environment. A team from Shaw Elementary participated in the Making Spaces program offered through the Amazeum. This program gave Shaw Elementary teachers the opportunity to learn more about integrating making and tinkering in the classroom. Building this community of practice has provided the school with a new outlook on innovative education and the resources needed to make this type of learning more meaningful.

guiding practices in the Wonder Lab

When asked what excites Kim most about teaching and being involved with the Wonder Lab, she responded, "I love preparing kids for the future. That's really what my passion is...whether it's being a reader or being a learner who can take risks and not [being] afraid to fail...we'll try and then try again to solve a problem." Her role as the school librarian places Kim in a unique position to do just that, as she weaves books into STEAM content. This library influence is evident throughout the Wonder Lab, both physically in the displays and in the curriculum as design challenges inspired by literature are posed to students. Kim's philosophy of developing the whole learner is evident in her comment about classroom management in a space as open and exploratory as the Wonder Lab: "I've figured out that behavior is probably a cry for 'I need another way to learn.'" Creating the Wonder Lab has helped her understand "the motive or see the inside need as a kind of call for help and a trigger that you need to do something different with that learner." The Wonder Lab has provided that "something different" for many students at Shaw Elementary. This includes the practices of technology and engineering through hands-on application to allow students to see the real-world use of mathematics and science content and make learning more meaningful (Cunningham & Lachapelle, 2014; Weaver, 2017).

Figure 2. Students are designing and building bridges with MakeDo cardboard construction tools.

Julie comes alive as she discusses the Wonder Lab. Her excitement lies in "seeing those kids that get it, you know, that lightbulb goes off and they're like, 'Wow, I can do this!' [I love seeing] the confidence when a kid knows they can do something; when they are so proud...so excited!" Her favorite moments in the Wonder Lab come from watching students work hard on projects and "put in the time" to build something they are proud of..."it's those moments when they're so proud of themselves" that confirm to Julie that she is in the right place. Julie gets almost as excited as the students in the Wonder Lab, "when they're proud...it makes them feel good. They know they can do it. That's what gets me excited...when those kids light up and they get it. We have several projects over there that aren't done, but they don't want to stop. They ask, 'can we put it over there and finish it later?'... That means something, you know, they're really working and trying. I love that."

learning in the Wonder Lab

Kim's vision is that the Wonder Lab will be a place where each and every student at Shaw Elementary will thrive.

> "We just truly believed that it should be a place where every student gets to come. Every student should have the opportunity to have these foundational skills, to explore circuitry or explore an engineering objective, whether you are finished with your classroom work or not, whether you've had good behavior or not. And what we found is that those very students are the ones who excel in here. This place just levels the playing field. I mean, everybody's the same, there's not high, low, there's not good behavior or misbehavior. There are just kids who learn."

It is difficult to label the type of learning that takes place in the Wonder Lab. Kim and Julie have truly made it a place for every learner. The team has integrated STEAM learning standards into each challenge presented to students, including the Arkansas Science Frameworks (adapted from *Next Generation Science Standards*, Arkansas Mathematics Standards (adapted from the *Common Core State Standards for Mathematics*), and Arkansas Visual Arts Standards (Arkansas Division of Elementary and Secondary Education, 2020). There are learning areas focused on individual STEAM concepts and integrated challenges throughout the room in various formats. Nonfiction and fiction texts support these challenges at stations that also include various tools and materials with intentional mathematical practices woven throughout. This team of two works tirelessly to make the Wonder Lab a meaningful extension of the regular classroom. Julie believes strongly that, given the right materials and the space to investigate, students can do amazing things! She is purposeful with what

Figure 3. Top: A student creates a marble maze using magnets on a whiteboard. Bottom: Students explore mixing colors with sand on a light table.

is presented in the Wonder Lab: "I don't want a lot of examples around because a lot of kids will just do exactly what I show them. And I don't want them to do exactly what I did. I want them to do their own thing." These ideas fall in line with the research on design fixation and how showing images or examples of potential solutions may hinder student creativity and divergent thinking (Bartholomew & Ruesch, 2018).

Some observers might describe the learning as exploratory, others as structured play, others still could describe it as experiential. Kim describes it as open-minded and open-ended; it's "creative with a little bit of structure." She indicates that "I always try to remind myself that I need to step back and let them fail, let them make mistakes and let them…just broaden their little world of learning somehow." Julie wants the space to be "visually stimulating," a place where students can "think and have fun and be curious." She and Kim work hard to make it a place that gets students "thinking and wondering…and not stopping just because they leave here!"

Many of the projects that students complete in the Wonder Lab are structured to focus on science and mathematics standards. Other projects such as the Break It and Make It workbench are selected by the students. For this challenge students take apart and save (Break It) electronic parts to be repurposed with future STEAM design challenge projects and inventions (Make It). The book, *Things Come Apart*, by Todd McLellan is a perfect companion to this activity. Sample projects from the Wonder Lab can be seen in Figures 1-5.

future goals and inspirations

This school year each of the kindergarten classes visits the Wonder Lab weekly as a special designated class such as art or music. Kim and Julie are amazed at the experiences these kindergarten students will have had by the time they reach the fifth grade. Those students will be exposed to a wide variety of STEAM fields, with hands-on experiences to encourage and support current and future classroom learning. Learning is taking place in the Wonder Lab because students are given the freedom to make choices and to exercise their creativity. Students are encouraged to take risks by "thinking outside the box" and are provided an environment in which they are exposed to new and engaging challenges.

Many of the students who struggle in the traditional classroom setting seem to thrive in the Wonder Lab, where they can learn through the application of knowledge. Kim and Julie have observed that many students who are considered gifted in traditional classes actually depend upon teammates who may struggle with traditional learning. Kim and Julie believe that the Wonder Lab's learning environment helps to nurture struggling students' self-efficacy and self-esteem, and they hope that this success carries over into other areas of their lives. Students begin to recognize talents they have never had the opportunity to explore and cultivate. Kim and Julie believe that this enthusiasm and discovery that takes place in the Wonder Lab is taken back to the classroom. Since the implementation of the Wonder Lab, the leadership at Shaw believes that students are more comfortable verbally discussing and defending their ideas and are more willing to try new methods. They are also more confident in their ability to think critically and transfer both knowledge and skills as they solve problems and develop solutions.

To see more of the Wonder Lab, follow them on Instagram @shawwonderlab. For more information or additional reading to jump start your own Wonder Lab, consider the following book suggestions from Kim Gadberry.

Steam Makers by Jacie Maslyk. Maslyk's book provides educators with a plan for "fostering creativity and innovation in the elementary classroom." Maslyk presents the importance of giving students a "maker" mindset and acknowledges that changes in school may be difficult. The ideas presented from both a teacher and administrator perspective echo throughout the Wonder Lab.

Launch: Using Design Thinking to Boost Creativity and Bring Out the Maker in Every Student by John Spencer and A. J.

Juliani. In this book Spencer and Juliani weave a powerful narrative of the importance of providing students opportunities to create and design. They include sample lesson plans and examples for how teachers can develop a creative classroom.

Empower: What Happens When Students Own Their Learning by John Spencer and A. J. Juliani. In this book Spencer and Juliani create a road map for teachers to develop a classroom in which students have both choice and voice related to integrated learning. They discuss the importance of tapping into students' natural curiosity to empower their learning.

The Most Magnificent Thing by Ashley Spires. Spires' book tells the story of a young girl who discovers that, through perseverance and determination, she can make her dreams come true. The story reveals the critical aspects of learning from one's mistakes and having a growth mindset and inventive spirit.

Figure 5. Top: Students explore pushes and pulls. Bottom: Students use magnet gears to cause a chain reaction.

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