THE SMU MAKER EDUCATION PROJECT

PIPE CLEANERS TO POWER TOOLS

How Maker-Based Instruction Transformed Space and Equipment into a Curriculum at Solar Preparatory School for Girls

When Solar Preparatory School for Girls opened in 2016, the public elementary school in Dallas already had a dedicated makerspace. It had a wealth of equipment: 3D printers, Little Bits circuitry components, and Dot and Dash, robots that students can program. It had the time, with thirty minutes of Maker-Based Instruction (MBI) in every student's day.

"But how are they spending that time?" Solar Prep's Assistant Principal Jennifer Turner asked herself.

> "How do you take this thirty minutes and make it a really meaningful thirty minutes for the kids?"

Without much training in MBI, Solar Prep's students were exploring materials like cardboard sheets and hollow, jointed tubes that they could combine to build a simple structure. It was fun, but Turner questioned its educational value. "The girls were not walking away from the makerspace with more than they walked in with," Turner recalls.

Solar Prep is an innovative public school getting national attention, including from the New York Times. In the sprawling Dallas Independent School District, it's designated as a "transformation school," a choice school with rigorous academics but open to students without regard to ability. Families are enrolled by lottery. It will add a grade per year until it includes kindergarten through eighth grade.

Because the school is meant to be a model for others, Turner says, "It is important for us to get it right, not only for our girls but to impact as many kids across the district as we can." To get Maker-Based Instruction right, then, she turned to the SMU Maker Education Project team, which she had met at a professional development session a year before. Turner knew that Katie Krummeck, who at the time was directing SMU's Deason Innovation Gym (a collegiate makerspace) had expertise in bringing MBI to K-12 schools. During their first meeting, the makerspace teachers and the SMU team created learning objectives for the makerspace that aligned with the "Solar Six" – the school's core competencies. The Solar Six include Curiosity, Self-Awareness, Empathy, Humility, Leadership and Grit, all affective learning objectives that are well-supported by MBI.

> "Imagine a world where everything is possible."

The SMU team worked with Solar Prep's Instructional Coach, Olivia Santos, to develop a daylong Maker-Based Instruction training session and monthly makerspace coaching sessions for the teachers. Teachers were skeptical at first. "They're hardworking and talented teachers," Santos says.

At the daylong workshop, the SMU team asked the teachers a pressing question: How might we help people spend less time on the Dallas area's tangled network of highways? Teachers developed low-resolution prototypes of everything from autonomous pods to party buses that picked up individual cars.

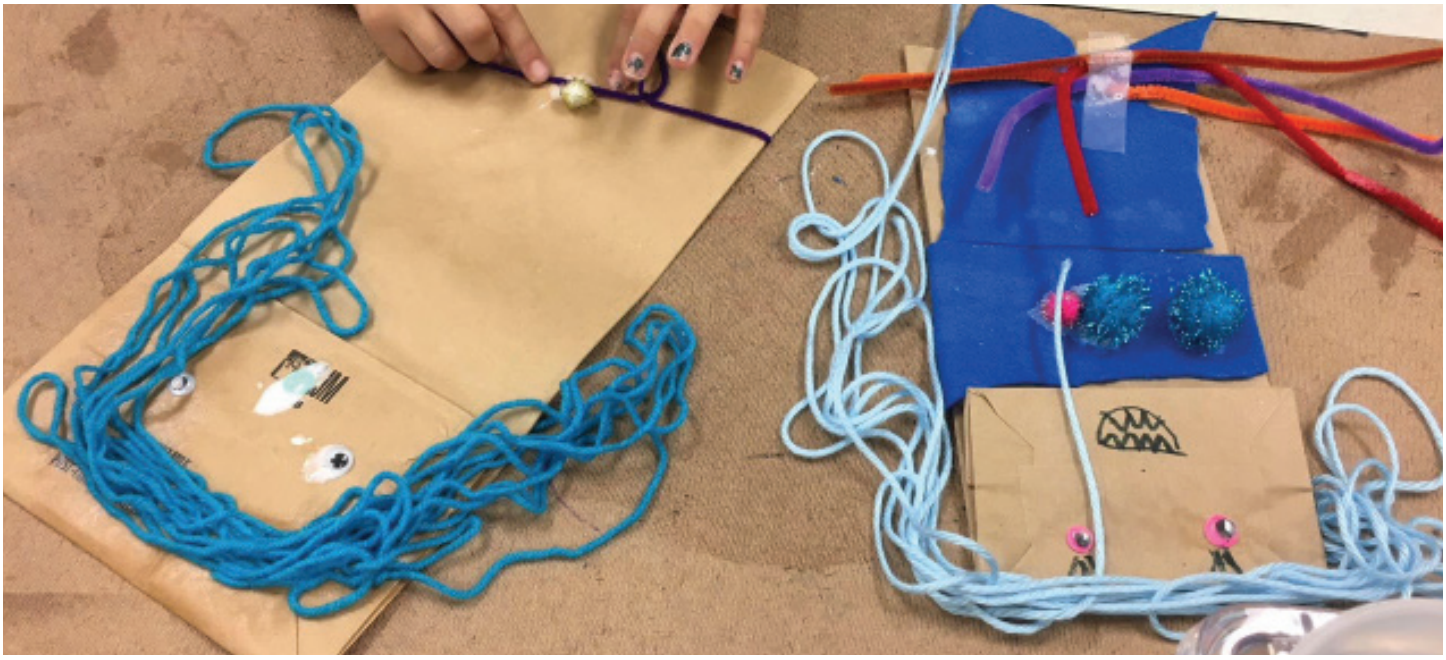
By the end of the day, Santos saw the teachers' mindset shift. As time ran out, they asked, "Can we have five more minutes?"

> "The teachers were skeptical of Maker-Based Instruction at first. By the end of their daylong workshop, they were asking, "Can we have five more minutes?"

Santos says, "Where they really saw value was in the next phase: seeing how a task like that could work in their classrooms with almost any content." They learned "not to limit yourself to what is possible. Imagine a world where everything is possible." The goal, Santos says, is to get the students to think of potential before they think of limits and then build on that potential through making.

Triangles and Tears

At the core of SMU's model for Maker-Based Instruction are "Maker Sprints," activities that take place in the makerspace that are built around developing a proficiency in a specific skill and then using that proficiency to solve a problem. One three-day sprint with the kindergarten class focused on pipe cleaners.



On day one of the sprint, teachers asked students to explore pipe cleaners and identify what they were able to do with them. Students found that they could bend the pipe cleaners, tie them in knots, and link them together. On day two, students performed a simple task. With the pipe cleaners, they created shapes – triangles, rectangles, squares.

On the third day, students undertook a more complex project. They looked at pictures of buildings to identify what shapes they were made of, and then reconstructed them with pipe cleaner shapes.

The sprints do more than bring together academic knowledge with technical know-how. They bring in emotional knowledge, too. Turner says that one girl who was academically strong struggled on day two of the pipe cleaner sprint and started to cry.

"She can read, but when you ask her to turn a pipe cleaner into a rectangle, everything falls to pieces," Turner says. This frustration can be a test of grit, one of the Solar Six competencies, according to Turner. "It creates an opportunity to be challenged in new ways."

"You see a lot more tears in the makerspace than anywhere else. The kids are pushed out of their comfort zone more than they are in the classroom," Turner says. She adds that in the makerspace, students learn to fail and then try again. They learn when to persist and when to walk away from frustration. "It's an opportunity to build self-awareness," she says.

Higher Resolution

Through its makerspace, Solar Prep is literally building students' toolkit. Santos sees it as a nine-year progression from simple, low-resolution tools and materials to much higher-resolution ones. The school plans to get the girls ready to "utilize any tool they want to, to create prototypes and solve real-world problems," Santos says. By eighth grade, the kindergarteners trying to master pipe

cleaners will be comfortable using power tools.

The collaboration with SMU "was so valuable to help us figure out what we were doing. It was a lifesaver," Turner says. The consultation and training brought structure to Solar Prep's makerspace programing. It made instruction in the makerspace much more intentional. "We would be lost without them."

Santos found collaborating with the SMU Team to be "critical" to the makerspace's success. She says the school benefited from "brainstorming with them on how to run a sprint and make the best use of time for the girls."

The Difference a Truck Makes

By late spring in Solar Prep's first year, "the makerspace idea had become second nature" to the girls, Santos says.

Then the SMU MakerTruck showed up. "They were blown away," Santos says, when the truck rolled in for the school's career day and the students saw that Maker-Based Instruction isn't just something they do at their school. It's something they can do all the way up through college and beyond.

Using the truck's equipment and the SMU team's guidance, students made jewelry and circuits with LED lights. They also asked the SMU team, "How can we get this job?"

> "When the SMU MakerTruck rolled up, excited students asked the SMU Maker Education team, 'How can we get this job?'"

Solar Prep and SMU's Maker Education Project team continue to collaborate. As the school grows,

its next Maker Sprints will involve 3D printing, graphic design, vinyl cutting, and filmmaking. Santos sees working with the SMU team on the makerspace as "one of the most exciting things about Solar." She says the SMU team members are "pioneers in maker education in Dallas and the nation. It's something we're very fortunate to be able to experience."