

A Rural Navajo Reservation Makerspace

By Jennifer Miller, Thomas Tomas, Nancy C. Maryboy, and David Begay

A remote Navajo reservation school is broadening its instruction through a makerspace for an under-represented and disadvantaged population of students. The Little Singer Community School (LSCS) is located in Birdspring, Arizona, in the southwestern portion of the Navajo Nation in northeastern Arizona. Students attending the school have limited access to enhanced learning experiences.

Two LSCS teachers, Wilphina Becenti and Thomas “Tom” Tomas, have master’s degrees with an emphasis in bilingual education, specifically pertaining to Navajo and English languages, so most students receive some instruction in the Navajo language and culture. But prior to this program there was little training in STEM literacy and makerspace pedagogy, and LSCS lacked equipment to provide strong training in engineering and the sciences overall.

That all changed in 2017, when LSCS partnered with NASA’s Magnetospheric Multiscale Mission (MMS), the NASA Space Science Education Consortium (NSSEC), NASA Goddard Space Flight Center’s Innovation Lab, the Indigenous Education Institute, Navajo Technical University, Sul Ross State University (SRSU), and Google to bring STEM career awareness to students through teacher training in a makerspace environment. The LSCS makerspace program facilitates a four-workstation, project-based learning approach connecting the makerspace to classroom curriculum. Jennifer Miller, an assistant professor in the College of Education and Professional Studies at SRSU, worked with new LSCS professional development coordinator Tomas to create a professional development makerspace program for teachers based on the August 2017 U.S. solar eclipse.

The curriculum of this makerspace program was unique in that it drew connections between Navajo cultural topics and science literacy classroom activities. The goal was to improve teacher performance and bolster their confidence in teaching STREAM



A fifth-and-sixth-grade LSCS team poses in front of their wind turbine model that took first place at the 2017 KidWind Challenge. The students applied their understanding of biomimicry by designing their turbine blades to look like raindrops. Photo courtesy LSCS

(science, technology, reading, engineering, arts, and mathematics) content so that they could more effectively encourage students to pursue careers in STREAM disciplines—with special emphasis on the STEM disciplines. Organizers believed that if classroom STEM instruction included elements of Navajo cultural heritage, then engagement and interest in STEM literacy would improve and more students would consider pursuing a STEM career pathway.

A HOLISTIC APPROACH

Scholars describe the importance of a holistic approach—using a range of activities and learning

environments—toward learning. Makerspaces can facilitate activities that meet the needs of diverse learners. Successful makerspaces, particularly in education environments, “balance practicality with creativity and collaboration to serve the needs of the school community” (Range & Schmidt, 2014). Purposefully designed makerspace environments may increase the engagement of youth in problem-solving. Finally, the making process allows learners to share their perspectives and cultural experiences in their native Navajo language in addition to English, increasing literacy skill sets.

THE PROCESS

LSCS teachers were introduced to STEM literacy and project-based learning in a makerspace learning environment during a summer 2017 training workshop. Training participants read Baje Whitethorne’s children’s book *Sunpainters: Eclipse of the Navajo Sun* and were instructed to ask themselves four questions as they read: *What do I know? What do I want to know? How do I find out? What have I learned?* Afterward, participants did a short rotation exercise, demonstrating their comprehension of the story by presenting positive statements and questions on sticky notes.

Next, the teachers were introduced to a project-based activity using challenge cards to teach STEM literacy. Teachers learned how to create learning activities using four different types of career skills: the scientist (investigator), the engineer (designer), the artist (creator), or the journalist (communicator). Challenge cards incorporated the use of new technologies to facilitate each career skill set, including a green screen, fabrication printers, bean weaving loom kits, a quadcopter, cameras, telescope camera adapter kits, Raspberry Pi computer units, art supplies, and circuit kits. Teachers were introduced to coding, 3D printing, and other STEM technologies as part of the training.

TAKING MAKING TO THE STUDENTS

Teachers repeated the makerspace project-based learning activity with LSCS students later in August to celebrate the solar eclipse. Students were encouraged to create their own challenge cards, and Becenti

reported that the children really took an interest and that the makerspace process created excitement. She stated that “students were surprised by how much they learned and responded well to creative teaching versus traditional teaching.” She added that makerspace activities were an effective introduction to Diné (Navajo) thought and brought attention to how students need to be aware and respectful of natural surroundings.

And the benefits didn’t stop with completion of the solar eclipse projects. LSCS students and teachers continued to incorporate the makerspace project-based learning process throughout the school year, incorporating Navajo stories such as *The Goat in the Rug* by Charles L. Blood and Martin Link. Students presented makerspace projects to their chapter house and the larger Navajo community. They participated in Navajo Technical University’s Key’ah Advanced Rural Manufacturing Alliance (KARMA) challenge under the visionary leadership of program director Benjamin Jones and won first place.

NON-STEM BENEFITS OF MAKERSPACE ACTIVITIES

Makerspaces serve to promote a stronger cultural understanding through the art of making. As each learner participates in an activity, they share research perspectives, debate approaches, learn about other

A fifth-and-sixth-grade LSCS team took first place at the Key’ah Advanced Rural Manufacturing Alliance (KARMA) Product Challenge, hosted at Navajo Technical University in May. Photo courtesy Chase Bebo





Four LSCS fifth and sixth graders placed, with two earning first place, at the Navajo Nation Science Fair in February. Photo courtesy LSCS

cultural perspectives, receive feedback from peers, and hone conflict resolution skills.

Becenti was so inspired that she created her own version of the experience that weaves together Navajo cultural teachings and literacy activities. Her makerspace teaches K'é, the Navajo kinship system, which includes the interrelatedness of all things, including Mother Earth and the sun, stars, and moon. Similar to the process mentioned above, in this version, students read a story, test their comprehension, and create an "artifact" in the makerspace using challenge cards. (For example, one LSCS student created a clay horse challenge to represent an important K'é element). They then reflect on their makerspace design process by writing in their personal journals.

Afterward, students present their makerspace product to a larger community and then reflect on their design process and how they approached challenges. Student products are not graded, but students

are evaluated during the process of making, presenting, problem-solving, and working with teams. Teachers also review the students' journal entries.

LITERACY THROUGH MAKERSPACE

Students began presenting makerspace projects in their native language to their chapter houses and at school events in the fall of 2017. Within the past year, students have become proficient in STEM literacies such as 3D printing and the use of green screen, textiles, and coding. During the 2017–2018 academic year, two fifth-and-sixth-grade teams earned first place in two separate categories in a STEM literacy contest hosted at Navajo Technical University. In addition, two students earned first place at the Navajo Nation Science Fair, which allowed them to compete at the Arizona Science and Engineering Fair, where one earned third place in the environmental science category.

Other activities included a number of different science challenges and contests, field trips, and online science communication with students in other states. Teachers are ready and eager to continue this makerspace program that has such demonstrable social and academic benefits. ■

REFERENCES

- Blood, C. L., & Link, M. (1976). *The goat in the rug*. New York: Parents' Magazine Press.
- Kamkwamba, W., & Mealer, B. (2016). *The boy who harnessed the wind*. Penguin: New York.
- Range, E., & Schmidt, J. (2014). Explore, plan, create: Developing a makerspace for your school community. *School Library Monthly* 30(7): 8–10.
- Whitethorne, B. (2002). *Sunpainters: Eclipse of the Navajo sun*. Flagstaff, AZ: Salina Bookshelf.

Jennifer Miller (jennifer.miller@sulross.edu) is an assistant professor and reading specialist coordinator in the College of Education and Professional Studies at Sul Ross State University; **Thomas Tomas** (thomasn.tomas@gmail.com) is a fifth- and sixth-grade teacher as well as the STREAM program coordinator at Little Singer Community School; **Nancy C. Maryboy** (wohali7@gmail.com) (Cherokee/Navajo) is president and executive director of the Indigenous Education Institute and an affiliate professor in the School of Environmental and Forest Sciences at the University of Washington; **David Begay** (dbegay@gmail.com) (Navajo) is a vice president of the Indigenous Education Institute and an associate research professor in the Department of Pharmacology at the University of New Mexico.