SolarSPELL

Arizona State University

2024 Annual Report

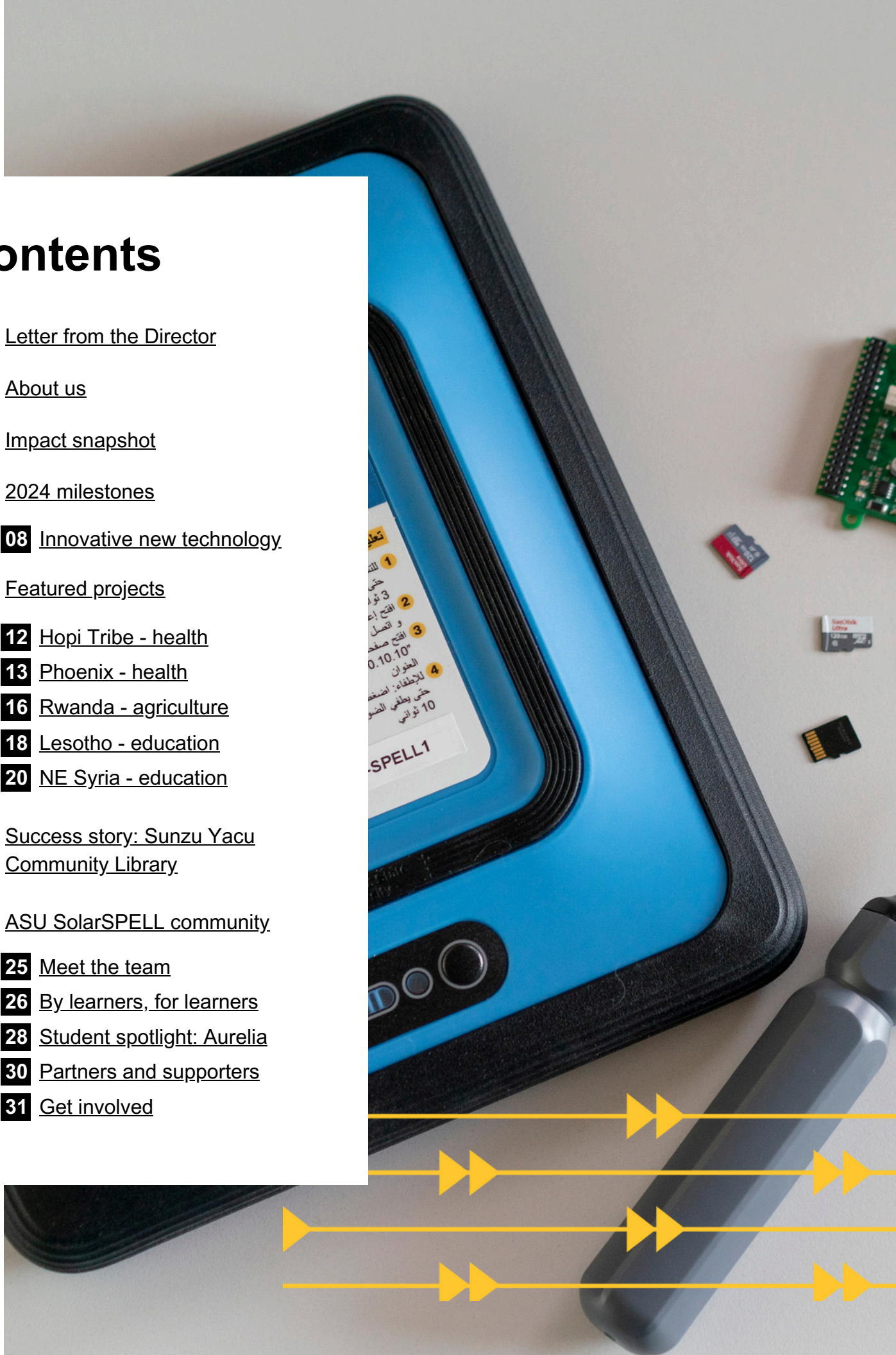
The ASU SolarSPELL Initiative empowers communities globally by **increasing access to information and building the skills** to make meaningful use of it.

SolarSPELL is a solutions initiative of

ASU Arizona State University

Lead librarian Appolo Dukuzimana helps students explore new resources on the SolarSPELL digital library in Rwanda's Sunzu Yacu Community Library.
Read about how this library is transforming education for learners of all ages on p.22.

Contents



Letter from the Director

Dear ASU SolarSPELL Supporters,

This was an exciting year for SolarSPELL, full of many new innovations, milestones and firsts for our team — chief among them the launch of our new offline digital library hardware! The patent-pending technology features an intelligent charge controller (which optimizes the amount of power extracted from the solar panel), as well as a streamlined case that is more durable and easier to use than its predecessor. Best of all, it was designed, engineered and built by ASU students, faculty and staff.

The new libraries made their debut in Rwanda, where we embarked on our largest project to date, implementing 70 agriculture libraries with B2R Farms. The conservation agriculture fellows we trained went on to teach 100,000 farmers climate-smart and sustainable farming techniques with the help of SolarSPELL libraries.

This year also saw the first domestic uses of SolarSPELL. Patient navigators in the Hopi Tribe are using our health library for community outreach around cancer screening and prevention. And the Phoenix Fire Department's Community Assistance Program is using our new crisis response library to better support city residents in crisis.

We also expanded to more schools in Lesotho and the Autonomous Administration of North and East Syria (AANES), leveraged AI to make library metadata tagging more accurate and efficient, and made the case for offline educational technology at the Continental Conference on STEM in Africa, organized by UNESCO and the African Union.

It was truly a banner year for the SolarSPELL Initiative, and we owe a great deal of the credit to you. Thank you for your continued support as we begin this exciting new chapter!

Laura Hosman

About us

Mission

The ASU SolarSPELL Initiative empowers learners globally by providing localized educational information and the training to build 21st century skills in offline environments.

Student success is central to our mission, both around the world and at Arizona State University.

Vision

We envision a future in which all learners everywhere have:
access to the information they need;
skills to turn information into knowledge; and
agency to transform knowledge into solutions.

How we change lives

We are **empowering community resilience** by building the most important skill for the 21st century — information literacy.

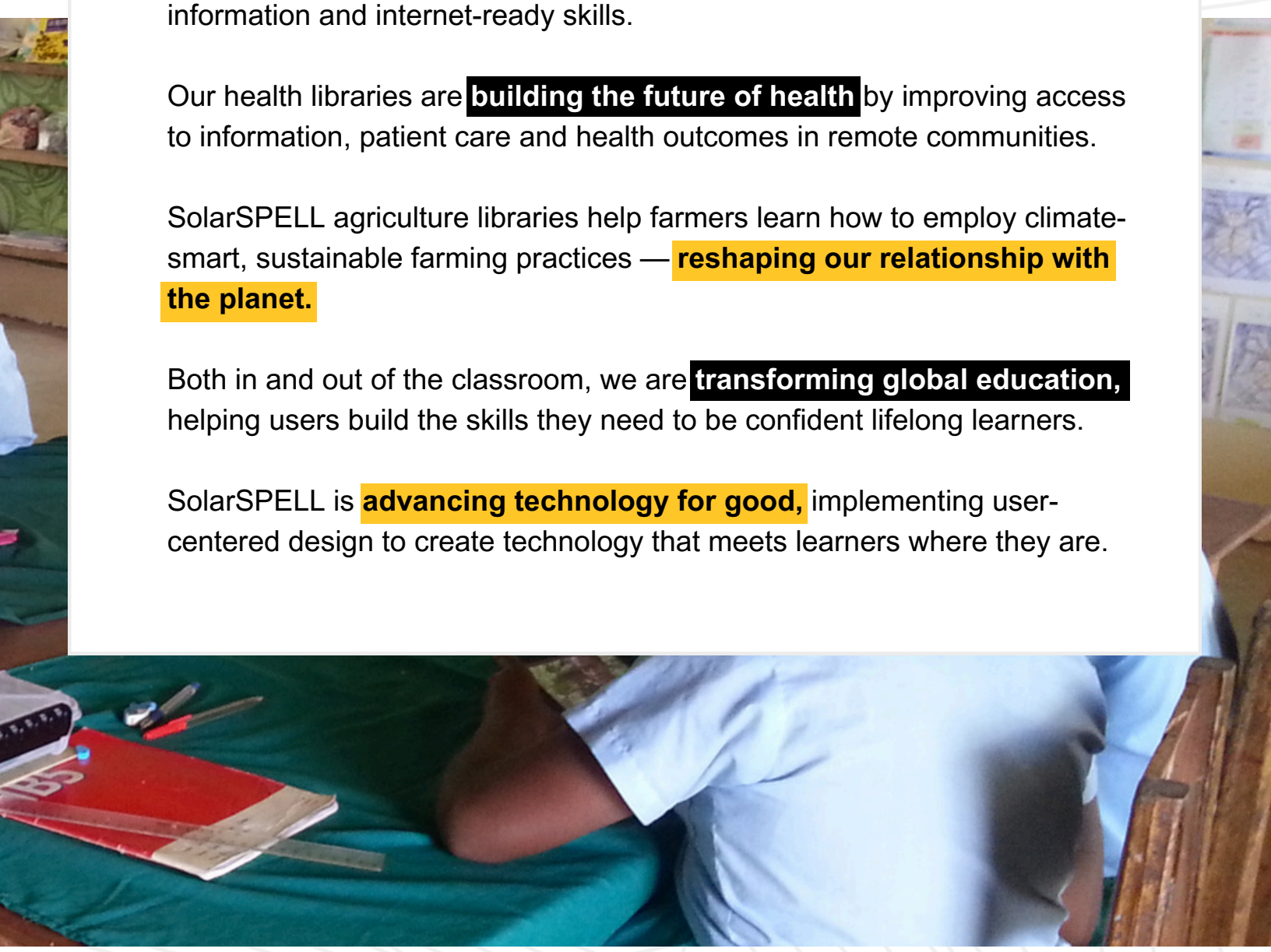
Most SolarSPELL libraries are in primary and secondary schools around the world, **inspiring and empowering tomorrow's game changers,** with information and internet-ready skills.

Our health libraries are **building the future of health** by improving access to information, patient care and health outcomes in remote communities.

SolarSPELL agriculture libraries help farmers learn how to employ climate-smart, sustainable farming practices — **reshaping our relationship with the planet.**

Both in and out of the classroom, we are **transforming global education,** helping users build the skills they need to be confident lifelong learners.

SolarSPELL is **advancing technology for good,** implementing user-centered design to create technology that meets learners where they are.



Impact snapshot

Our library users report:

92%

Feel better prepared to do their job

88%

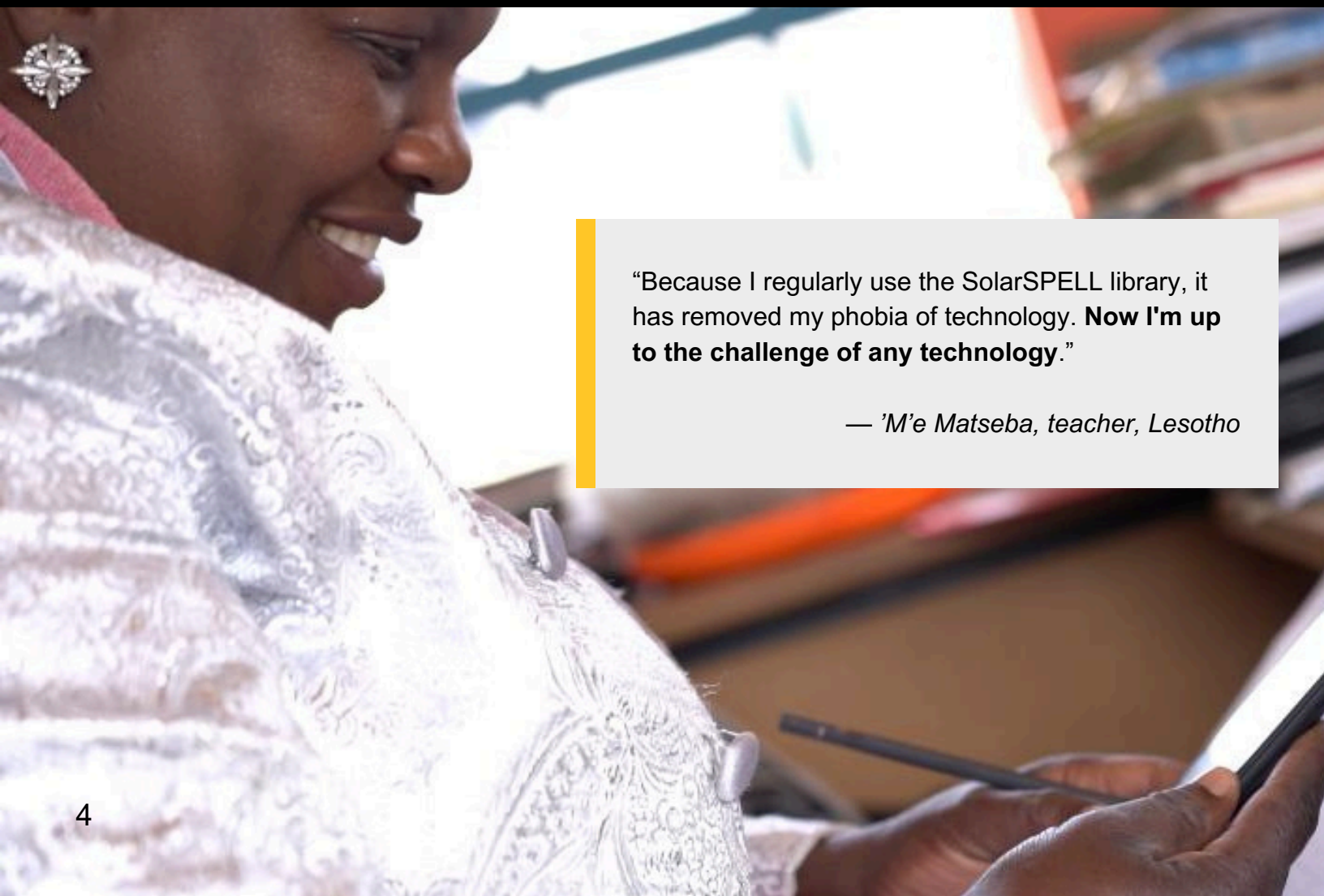
Report improved digital literacy

92%

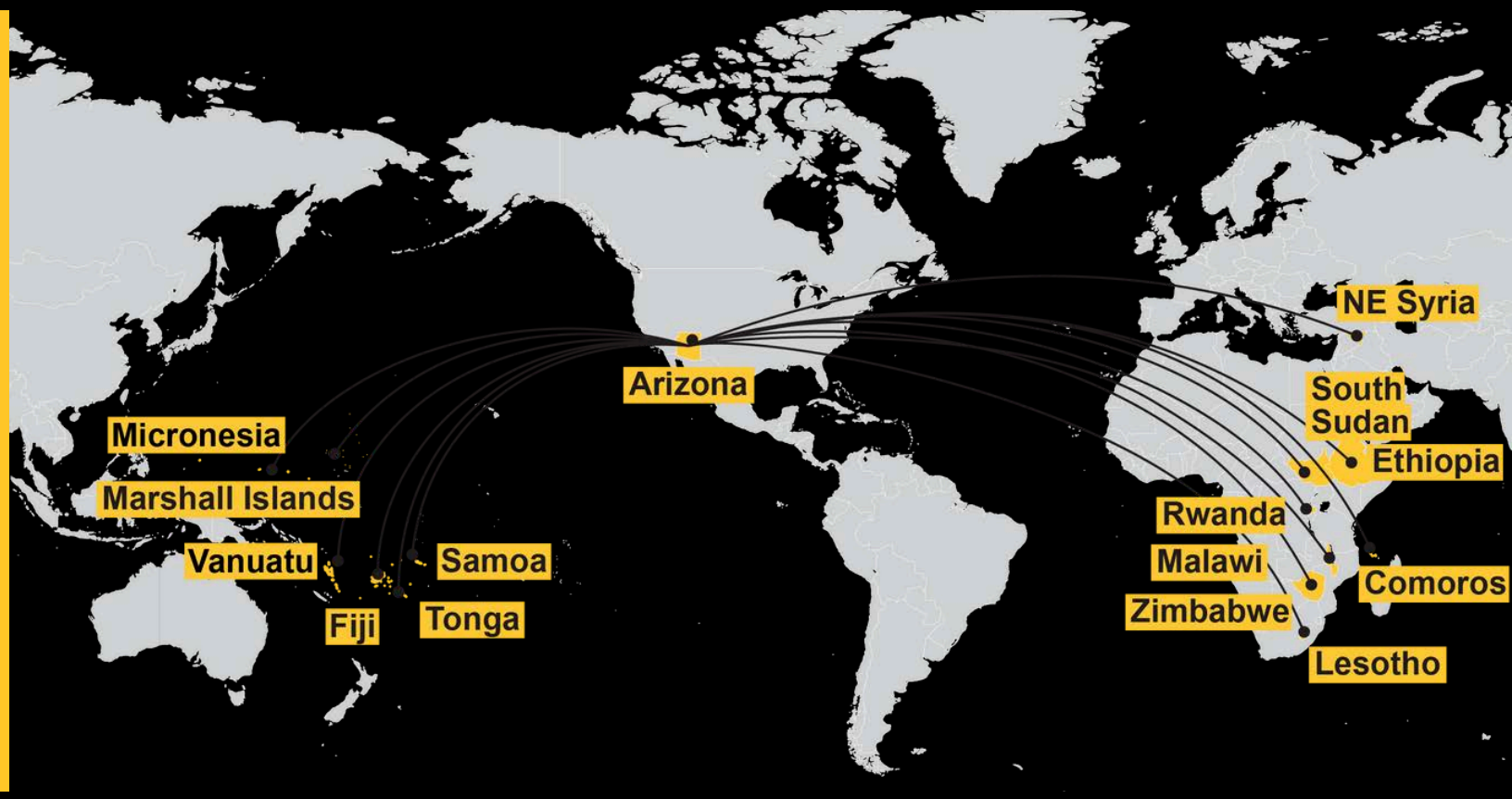
Say it supports their students' education

93%

Say it improved their patient care



> "Because I regularly use the SolarSPELL library, it has removed my phobia of technology. **Now I'm up to the challenge of any technology**."
>
> — *'M'e Matseba, teacher, Lesotho*



Global reach

612
Libraries implemented

1,092
People trained

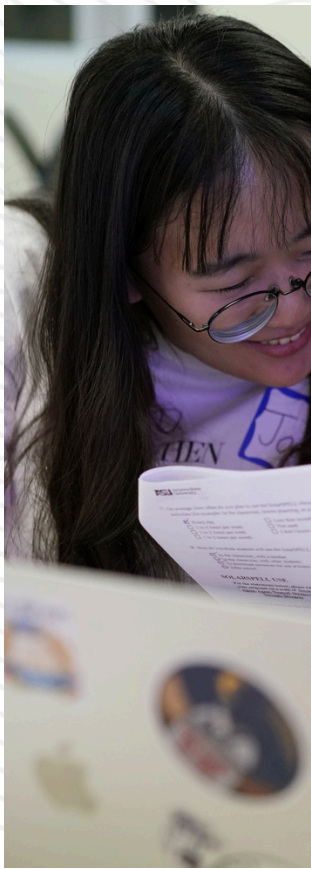
>420,000
Learners reached

2024 milestones

At its core, SolarSPELL is an initiative dedicated to learning and education. In addition to continuously improving every aspect of our work, we also strive to share our expertise in order to help others promoting access to information achieve greater good for more people by also building critical skills.

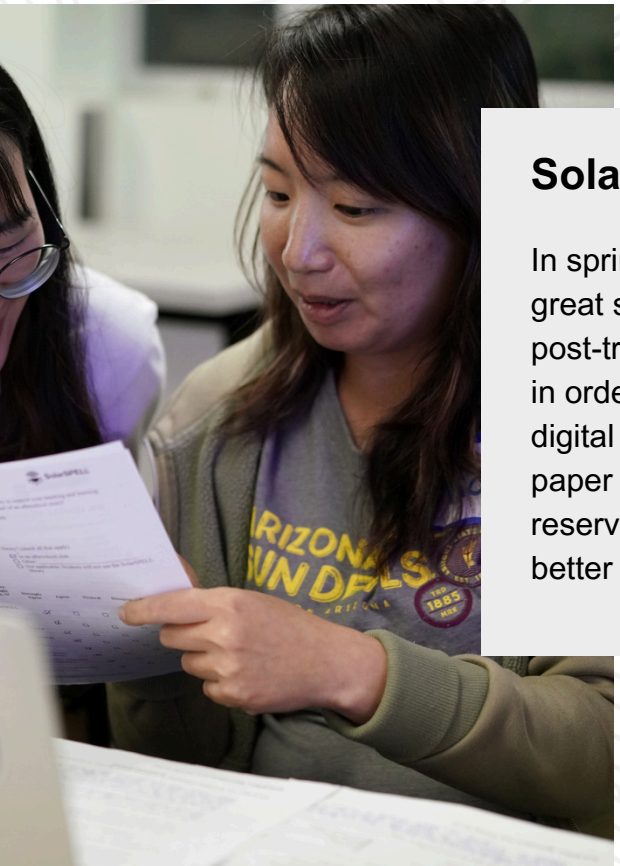
UNESCO STEM Africa

Co-founders Laura Hosman and Bruce Baikie were invited to represent ASU SolarSPELL at this year's Continental Conference on STEM: Transforming Science, Technology, Engineering and Mathematics in Africa, organized by UNESCO and the African Union. In addition to demonstrating SolarSPELL to visiting dignitaries, student groups and education professionals, Dr. Hosman was invited to present on how offline approaches to STEM education can be better than online — reaching all learners now, keeping them safe, bringing them empowering localized content and building internet-ready skills. Her comments were reflected in the recommendations read out during the conference plenary, which emphasized offline approaches, intra-networks and e-libraries.



AI Innovation Challenge

For three semesters in a row, SolarSPELL was selected to participate in ASU's AI Innovation Challenge, granting our team licenses to use ChatGPT Edu in transformative ways to shape the future of AI-enabled learning, research and work environments. After exploring its use in library content translation, quantitative data analysis and metadata creation, our team found it to be a game changing resource for generating metadata for resources in our libraries. The metadata developer GPT created by our MLIS intern Sina Muckenfuss has increased both the accuracy and efficiency of our library metadata creation, with student interns reporting that it's allowed them to curate double the number of resources. The tool is so useful, it's become one of the most popular GPTs used across ASU.



SolarSPELL's first Data-thon

In spring 2024, our team hosted our first-ever Data-thon event to great success! Since we aren't always able to administer pre- and post-training surveys digitally, we often rely on pen and paper. But in order to analyze this data, we have to input it manually to our digital tools. Student volunteers helped us enter responses from 96 paper surveys collected in Lesotho, Rwanda and the Hopi reservation — data we use to improve all aspects of our work to better serve library users.


SolarSPELL
Digital Library
Instructions
1 Turn on: Hold power button until red light turns on, ~3 seconds
2 On your device: Open WiFi Settings and connect to SPELL signal
3 Open a web browser and type 10.10.10.10 into address bar
4 Turn off: Hold power button until red light turns off, ~10 seconds
WiFi: SPELL
Web: 10.10.10.10
Arizona State University
This library was designed, engineered and created at ASU. Visit solarspell.org
Powered by Raspberry Pi
MADE WITH RECYCLED MATERIALS

SolarSPELL launches innovative new technology

Already the world's first and only digital library with integrated solar power, SolarSPELL further raised the bar in 2024, introducing new digital library technology that is more compact and easier to use than ever before. Designed, engineered and created here at Arizona State University, the new hardware features an intelligent charge controller, designed to maximize the amount of power extracted from the solar panel, as well as a more durable and streamlined case.

Since 2015, SolarSPELL libraries had been made using off-the-shelf materials, but in 2019 we began designing our own components to better meet users' needs. The effort to redesign our hardware involved **students, faculty and staff across ASU's Herberger Institute for Design and the Arts, Ira A. Fulton Schools of Engineering, and Core Research Facilities.**

Made with recycled plastic — another first in the world of digital libraries — the library's new case is shock-, heat-, dust-, and water-resistant. The hardware also introduces push-button on/off functionality, as well as an LED battery indicator display. And to help users determine the optimum time and place to charge their library, our charge controller monitors voltage and amperage, enabling us to show users via an offline web interface how much power is flowing into or out of the solar panel.

ASU SolarSPELL libraries have always used Raspberry Pi microcomputers to offer up the library via a Wi-Fi hotspot, and this version is no different. In fact, SolarSPELL is now one of 162 products to be granted official 'Powered by Raspberry Pi' status.

These new-and-improved offline digital libraries made their debut this year in Arizona on the Hopi reservation and in the City of Phoenix, as well as in Rwanda, where B2R Farms agriculture fellows used them to help train 100,000 smallholder farmers in conservation agriculture.

In recognition of its impact on community empowerment, the new SolarSPELL digital library has been selected as a finalist for the 2025 SXSW Innovation Awards. This incredible honor has just galvanized our team to continue innovating to make our libraries the best they can be.

Powered by Raspberry Pi

Featured projects

In 2024 we launched our first domestic projects right here in Arizona, expanded to more schools in Lesotho and Northeast Syria, and implemented our largest project to date, bringing 70 SolarSPELL agriculture libraries to Rwanda.

Hopi Tribe

Patient navigators at Hopi Cancer Support Services use SolarSPELL digital health libraries for cancer education outreach and case management.

5
libraries

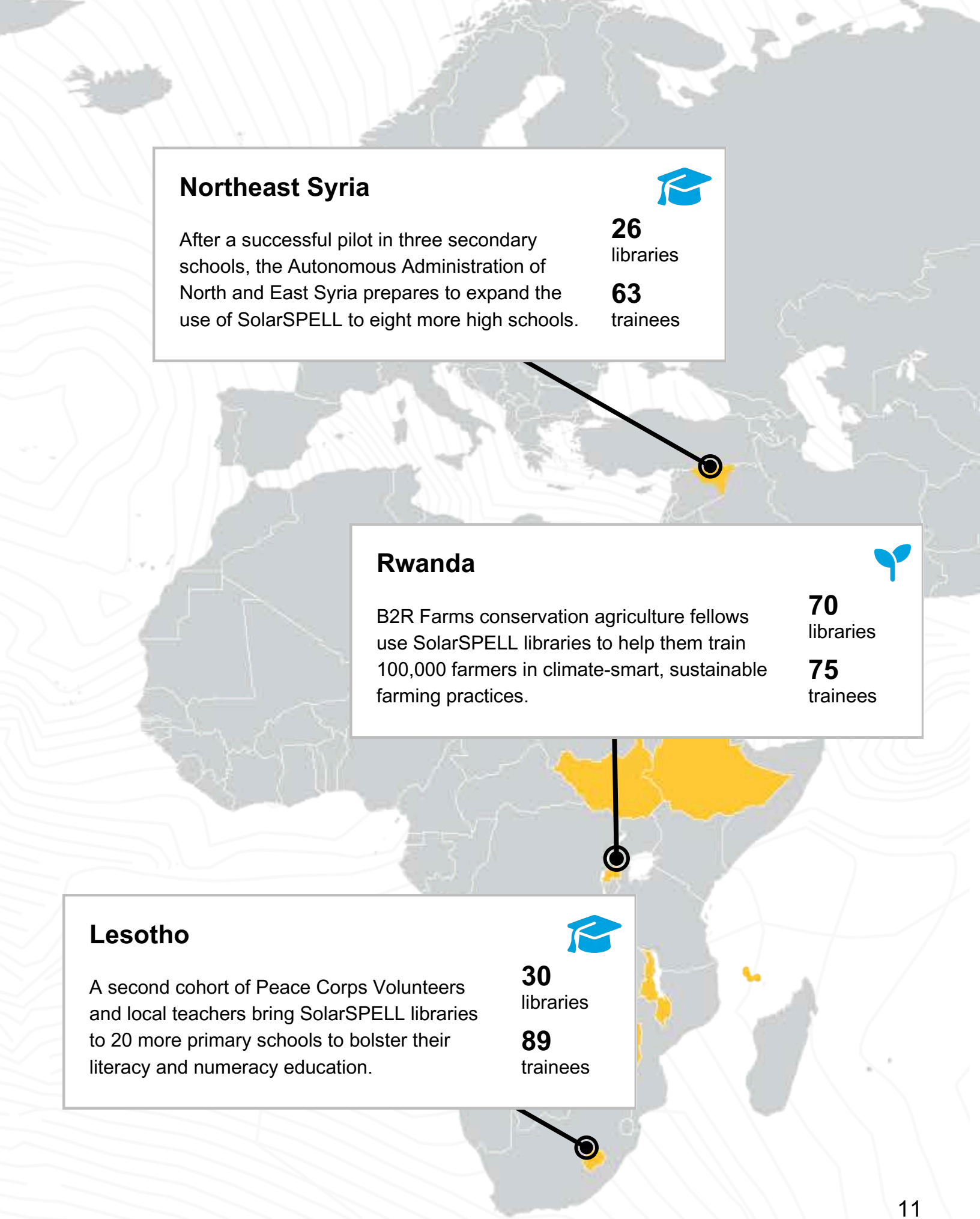
5
trainees

Phoenix, Arizona

The Fire Department's Community Assistance Program has incorporated SolarSPELL libraries to their work to help them provide resources to residents in crisis.

10
libraries

63
trainees



Northeast Syria

After a successful pilot in three secondary schools, the Autonomous Administration of North and East Syria prepares to expand the use of SolarSPELL to eight more high schools.

26 libraries

63 trainees

Rwanda

B2R Farms conservation agriculture fellows use SolarSPELL libraries to help them train 100,000 farmers in climate-smart, sustainable farming practices.

70 libraries

75 trainees

Lesotho

A second cohort of Peace Corps Volunteers and local teachers bring SolarSPELL libraries to 20 more primary schools to bolster their literacy and numeracy education.

30 libraries

89 trainees

Hopi Tribe

Native Americans face disproportionately high rates of cancer. Hopi Cancer Support Services (HCSS) is working to combat this disparity on the Hopi reservation in Arizona by offering cancer screening, education and assistance for patients undergoing treatment. Unfortunately, the lack of reliable internet access across this remote reservation has made it difficult for HCSS to provide residents with culturally appropriate cancer education materials.

In an effort to augment their cancer education outreach and case management, we partnered with HCSS to provide their health educator and patient navigators with SolarSPELL libraries full of culturally relevant health information. This project — championed by Doctor of Nursing Practice (DNP) student and Hopi tribal member Aurelia Taylor (*featured on p.28 in the student spotlight*) — marked the first time SolarSPELL has partnered directly with an Indigenous community and the first domestic use of our libraries.

Before launching the SolarSPELL Hopi Health Library in February, we spent several years developing our relationship with HCSS. This was critical both to build trust and to build the most relevant library possible. If resources aren't sensitive to Hopi norms and traditions around topics like nutrition, illness or death, the guidance they offer is simply not useful.

"It's the patient navigators themselves who are bringing this library around, and they were part of creating that library, so the patients know the content is trustworthy," said SolarSPELL co-director Laura Hosman.

> "SolarSPELL enables our patients, staff and community to access cancer-related educational material without the need for internet connectivity and empowers individuals facing cancer to better understand their diagnosis."
>
> — Kellen Polingyumptewa, Manager
> Hopi Cancer Support Services

Implementing partner

HOPI Cancer Support Services

Phoenix

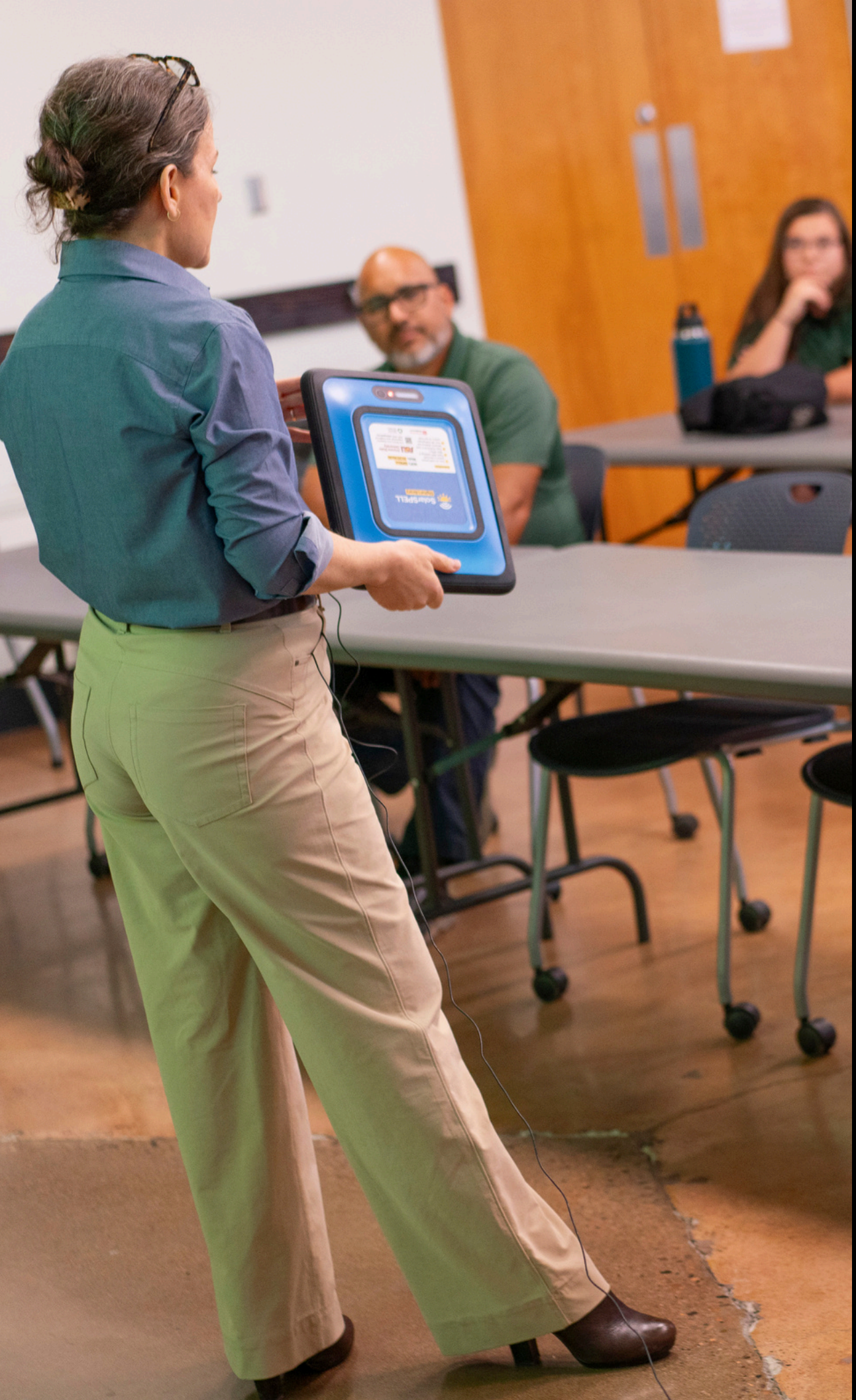
The Phoenix Fire Department Community Assistance Program (CAP) provides on-scene crisis intervention and victim assistance services to Phoenix area residents. In 2021, Heather Ross, co-director of SolarSPELL Health, participated in a ride along with one of CAP's crisis response units.

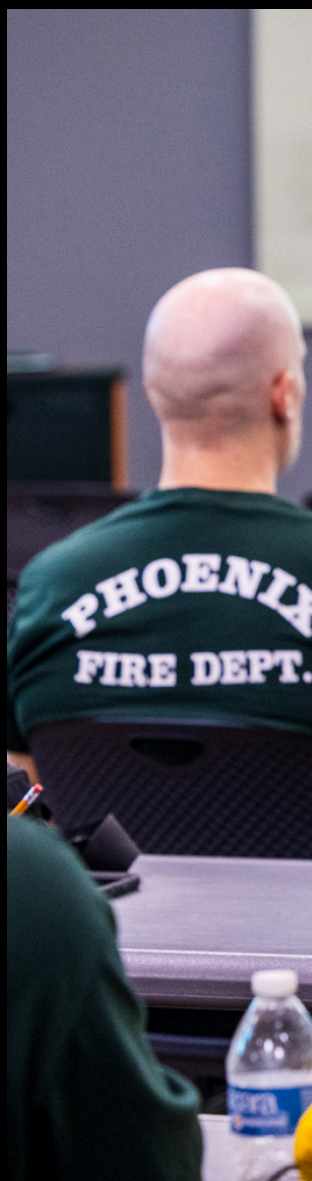
"I quickly noticed the giant hanging file cabinet that takes up a lot of space in the back of the van," she said. Within the cabinet were hundreds of files filled with brochures and information sheets for the crisis responders to hand out — paper handouts of crucial information that could be easily lost as people navigated their crisis. What if crisis responders instead had a way to help folks download these resources straight to their phones, without the need for Wi-Fi or a data plan?

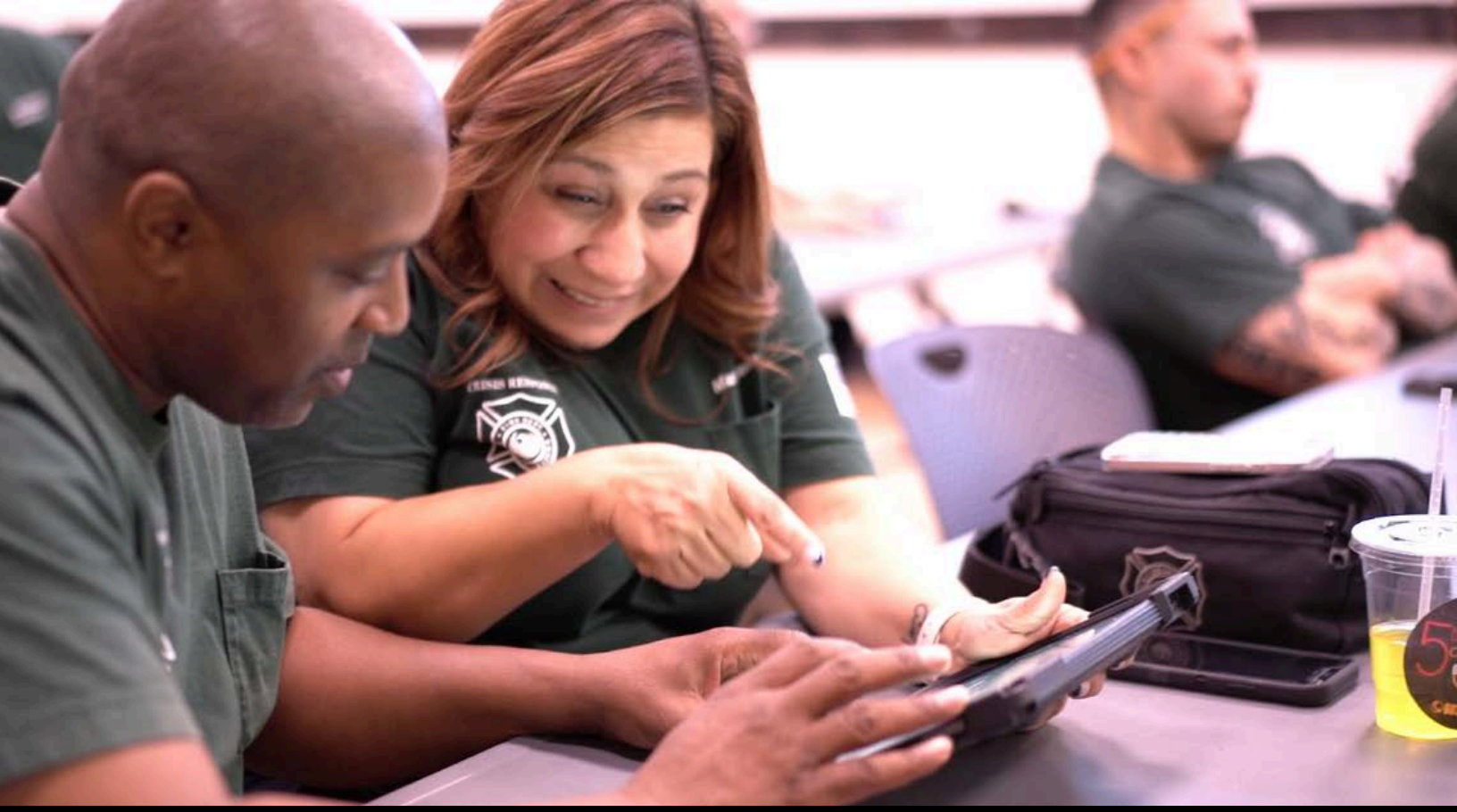
Thus began a partnership between SolarSPELL and CAP to curate a crisis response library collection. In addition to digitizing CAP's existing handouts, a team of ASU DNP students created low-literacy versions of each resource, using illustrations and simpler language. The library also includes a child trauma toolkit of games and drawing pads that responders can use to help ease and distract kids at a crisis scene.

In October, with the support of DNP student Patricia Inman who helped facilitate training and impact evaluation, we officially launched 10 SolarSPELL digital libraries with CAP, training both their crisis response and behavioral health units how to incorporate the library into their work. Already the program has expressed interest in expanding the project, adding new resources to the library and providing SolarSPELLs to nine additional response units in 2025.

Implementing partner




PHOENIX
FIRE DEPT.



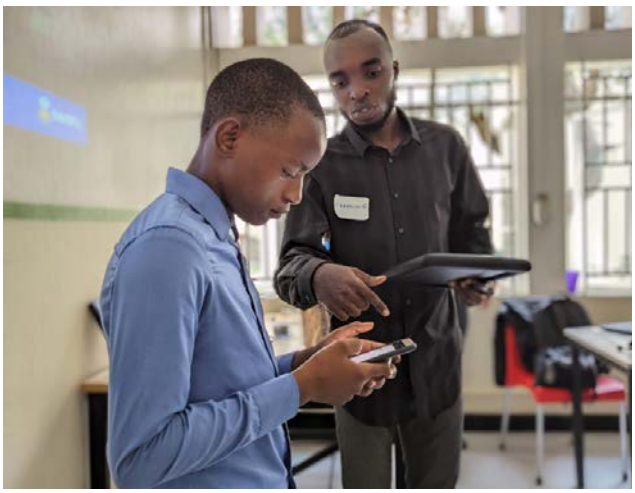

PHOENIX
FIRE DEPT.
PHOENIX
FIRE DEPT.

Rwanda

In Rwanda more than two-thirds of the population are small-scale farmers, relying on the land to feed their families. In order to improve food security and reduce the impact of climate change, nonprofit B2R Farms is teaching farmers across the country how to implement Foundations for Farming's conservation agriculture principles. SolarSPELL is now amplifying their efforts by empowering their agriculture fellows with the **world's first and only offline digital agriculture library.**

Leading up to our project launch, B2R Farms played a large role in helping us curate locally relevant agriculture resources, with interns translating and curating resources in the local language of Kinyarwanda and staff sharing training videos created by their team. When training day arrived in January, our team introduced new hands-on activities to help participants practice teaching digital novices how to use the SolarSPELL library.

Since then, the first cohort of B2R Farms fellows has incorporated SolarSPELL libraries to their work leading trainings, conducting site visits and providing remote support to smallholder farmers and government extension agents. In less than a year, they have trained 100,000 farmers in sustainable and climate-smart agriculture practices.



> “The SolarSPELL library will help me to save time, avoid fake information, reduce expenses to buy internet data bundles, gain digital information and increase food security.”
>
> — B2R Farms survey respondent

By the numbers

70
Libraries implemented

75
Fellows trained

100,000
Farmers reached

Implementing partner

B2R Farms

Lesotho

We continued our work with Peace Corps Lesotho this year, expanding to 20 more primary schools across the country to support schools as they work to improve their literacy, mathematics and life skills education. In 2018, UNESCO found that only 45% of Lesotho's students aged 7 to 14 could read proficiently (in English or Sesotho), and only 15% had strong math skills. Together, we're empowering teachers with more tools to turn this around.

At our January training with the new cohort of Peace Corps Volunteers and teacher counterparts, we were thrilled to be joined by SolarSPELL champions from two schools that received digital libraries in 2023. 'M'e Matseba, Paul, 'M'e Mabatloung and Madison shared their experiences — explaining how they addressed challenges and started new initiatives at their school with SolarSPELL at the center, from an after-school program to a community library.

By the numbers

100%
Feel more internet-ready + confident using digital technology

10,500
Learners reached

“Some of my kids made a 90 on their English test, whereas in the first quarter, the average was around the 30s. … I can tell a big difference. And the kids – seeing their results motivated them more to keep it up.”

— Samantha, Peace Corps Volunteer

“SolarSPELL has made the content we are delivering to learners easier, because learners understand better when they see, when they interact with the content. This has enhanced teaching and learning at my school.”

— Bokang, primary school teacher

Implementing partner

Peace Corps

Autonomous Administration of North and East Syria

Over the course of the 2023–24 school year, the Autonomous Administration of North and East Syria (AANES) piloted SolarSPELL libraries in three secondary schools throughout the region. After an overwhelmingly positive response from more than 600 students and teachers, we are working with AANES to expand to eight more schools in 2025.

Since training AANES senior education officials last April, our team has been hard at work improving the Middle East Education Library, adding nearly 700 new resources, including 450 videos created by the AANES Commission of Education. This is the **only offline, digital, Arabic-language library in the world.**

In October, we hosted our first Build Day since redesigning our library hardware and — with the help of current and former student interns — built 50 SolarSPELL libraries, 20 of which were sent to Northeast Syria. And to facilitate the use of SolarSPELL in the classroom, the U.S. Department of State has committed funding to procure 400 tablets to be distributed alongside the digital libraries.

> “The SolarSPELL library has improved my students’ ability to search for information and has enhanced their confidence in self-guided research.”
>
> — Teacher survey respondent

AANES has ambitions to expand this program to 200 schools, making SolarSPELL libraries available to tens of thousands of students and teachers. Meanwhile we're aiming even higher: "We aim to support educators and students throughout the Middle East, and in all regions where the internet is too expensive, unreliable or inaccessible," said SolarSPELL co-founder and co-director Laura Hosman.

By the numbers

96%

Say SolarSPELL supports their students' education

95%

Say students are better able to conduct research

Inspired by the challenges we faced while curating this library collection, our team published a paper exploring the barriers slowing adoption of open educational resources (OER) in resource-constrained locations.

Hosman, Laura, et al. "An Overview of Arabic Language Open Educational Resources (OER) for Primary and Secondary Education and Their Use in Offline Environments." Electronic Journal of E-Learning, vol. 22, no. 9, 3 Sept. 2024, pp. 01-14, https://doi.org/10.34190/ejel.22.9.3616.

Implementing partner

SUCCESS STORY

Community library uses SolarSPELL to empower lifelong learning

Overlooking Rwanda's Lake Burera, the Sunzu Yacu Community Library hums with activity. Primary school students quietly read aloud to one another, keyboards clack as 6th graders practice using Excel, and a hushed murmur can be heard from high schoolers preparing for their national exams. The library, which opened its doors in 2016, is located in a group of villages that have a combined population of 3,500, limited electricity and poor internet connectivity. Owned and operated by the Chapters Network, Sunzu Library contains 15,000 donated books, as well as a SolarSPELL digital library (which doubled the amount of educational resources Sunzu is able to offer).

Crucially, the library is staffed by a dedicated team of three librarians who manage the library's borrowing system and run weekly programs designed to meet community needs. One such program is the Candidate Program, in which librarians tutor students who are preparing to take their national exit exams to advance from one school to the next. Tom Allen, country director for Bridge2Rwanda and a driving force behind the library's creation, said that nearby Mwiko Primary School used to have years when no students passed the national exit exam. It is now one of the best schools in the district.

Though much of the programming is aimed at young people, Sunzu Library serves community members of all ages. The SolarSPELL, in particular, has had widespread appeal. While students use it to study for class and to practice their English through the Voice of America Let's Learn English module, adults use it to find agricultural guidance from Foundations for Farming. Lead librarian Appolo Dukuzimana noted that many older library patrons don't understand English, so having access to resources in Kinyarwanda via the SolarSPELL is a game changer for them.

This combination of free programming and information that directly addresses community needs draws huge numbers of people to this rural library — about 80 people a day. But the librarians recognize that not everyone has the ability to make the trek, so they developed a program to bring the library to them, traveling by bicycle to nearby schools. The digital library allows them to share many more books than those they are able to carry and enables teachers to download books right to their phones to use with their students again later.

> "We want to share this blessing to have SolarSPELL here, so we have an outreach program called Read Riders. We take bicycles, and we put tablets and the SolarSPELL in a bag, and we go to read in different schools around the community."
>
> — Appolo Dukuzimana, lead librarian, Sunzu Yacu Community Library

ASU SolarSPELL community

Many hands make light work, as the saying goes. We are deeply grateful to everyone in our SolarSPELL family who makes this work possible — from full-time staff to students and volunteers, organizational partners to community champions. Thank you for your dedication to empowering learners around the world.

Meet the team

Laura Hosman
Co-founder and Co-director

Bruce Baikie
Co-founder and Co-director

Heather Ross
Co-director, SolarSPELL Health

Sara Jordan
Library Information Specialist

Rachel Nova
Project Manager

Cassie Barrett
Student Engagement Coordinator

Abby Johnson
Communications Specialist

Jacob Shaeffer
Web Developer and SysAdmin

By learners, for learners

SolarSPELL is the only global digital library initiative that is created by students for students, by learners for learners. Student success is central to our mission, and students are central to SolarSPELL's success around the world.

In 2024, 117 students, interns and volunteers from 16 universities around the world contributed their time and talents to library development, impact evaluation, communications, digital course development and more. Our student engagement program also saw several firsts this year, including our first hybrid onboarding, first Data-thon and first Build Day for our redesigned library hardware.

"The most impactful aspect of working with SolarSPELL has been the hands-on experience and exposure to real-world challenges in eLearning development. Through this opportunity, I have gained invaluable insights into designing educational resources for diverse global users, refined my technical skills, and developed a deeper understanding of the importance of accessibility and inclusivity in education."

— Chia-Yu 'Joanne' Chang,
digital training course development intern

"The skills and perspectives I have gained have influenced my goals and strengthened my commitment to working on global development projects. I am incredibly grateful to be part of this initiative, not only for the meaningful work but also for the amazing mentors, friends, and colleagues it has brought into my life. What excites me most is the opportunity to grow alongside SolarSPELL as it continues to expand and create meaningful change around the world."

— Debo Ghosh, agriculture content curation intern

Industrial design intern Brandon Lê was a finalist for this year's Don Norman Design Awards for the housing he designed for SolarSENSE, an offline, off-grid soil sensor we're developing to give smallholder farmers access to actionable soil data.

"Working with SolarSPELL has given me the unique opportunity to design for first-time internet users in remote communities. This experience has deepened my passion for UX in EdTech and strengthened my belief in the power of design to drive social change. Grateful to be part of a team that's making a real difference!"

— Deeksha Rai, UI/UX + web design intern

During her graduate studies, ASU alum Libbie Farrell co-authored a paper examining offline digital solutions for education in emergencies, taking the use of SolarSPELL libraries during the COVID-19 pandemic in South Sudan as a case study.

Farrell, L., Hosman, L., Barrett, C. B., & Nova, R. (2024). Educational continuity in emergencies: The role of offline digital libraries in under-connected communities. Journal of Information Technology Education: Innovations in Practice, 23, Article 14. https://doi.org/10.28945/5385

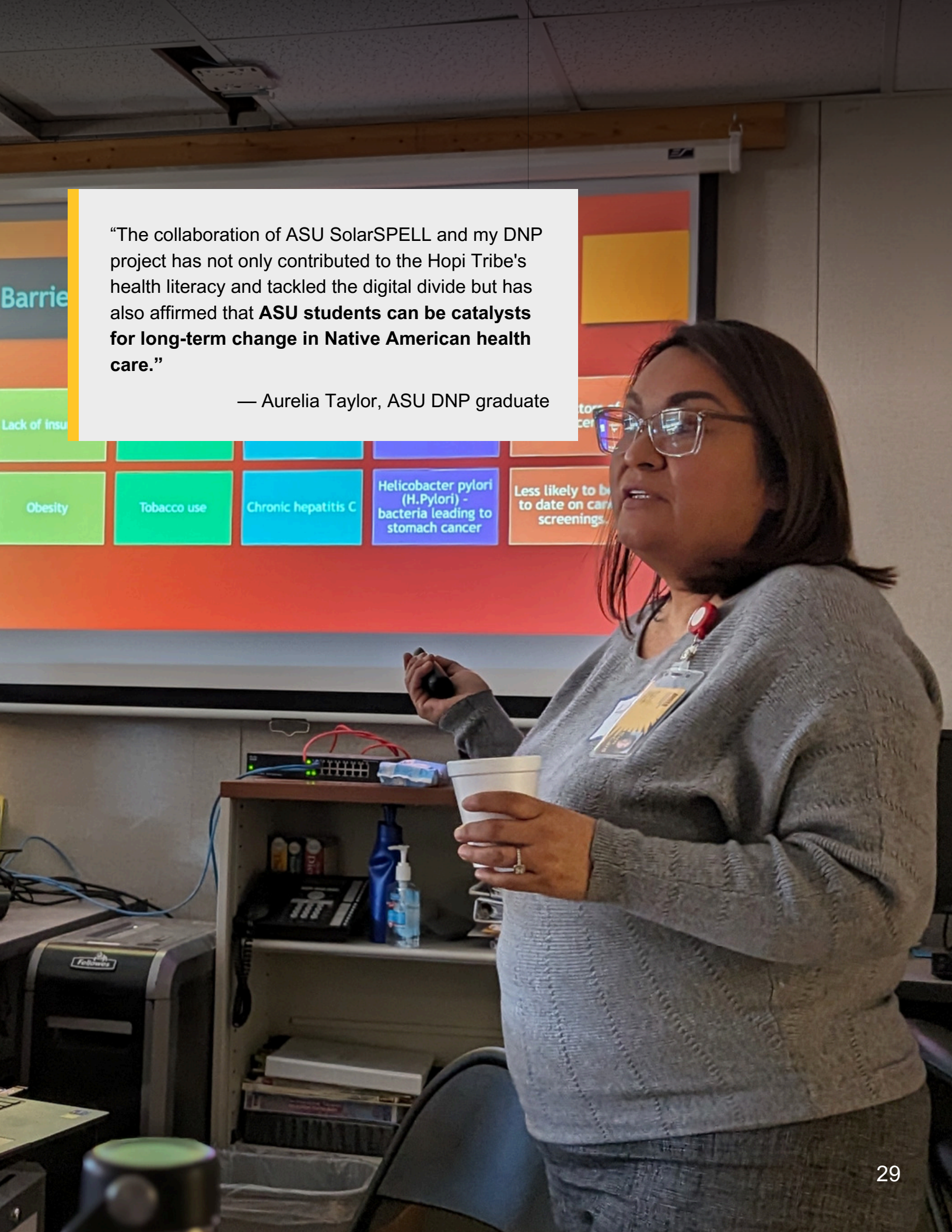
Student spotlight: Aurelia Taylor

Growing up on the Hopi reservation in northern Arizona, Aurelia Taylor experienced firsthand the effects of the Tribe's limited access to health information and care services. So she set herself on a path to fill this gap. She would become a nurse and dedicate her life to serving and advocating for rural communities like hers.

That path led her to pursue a Doctor of Nursing Practice (DNP) degree at ASU, where she first learned about SolarSPELL and saw an opportunity to use her capstone to serve her community. After connecting us with Hopi Tribe leadership, Aurelia created accessible and culturally relevant health resources that could be added to the library.

In February, she helped lead a SolarSPELL train-the-trainer workshop with Hopi Cancer Support Services patient navigators. During the training, Aurelia presented on the social determinants of health, cancer rates among Indigenous communities and the role of patient navigators — in each case noting opportunities for how the SolarSPELL library could be used as a tool for cancer education outreach and case management.

Since graduating in May, Aurelia has started work as a clinical coordinator at Flagstaff Medical Center and remains committed to making a difference in rural health care.



"The collaboration of ASU SolarSPELL and my DNP project has not only contributed to the Hopi Tribe's health literacy and tackled the digital divide but has also affirmed that **ASU students can be catalysts for long-term change in Native American health care."**

— Aurelia Taylor, ASU DNP graduate

Partners and supporters

SolarSPELL is grateful for the collaboration and contributions of our partners and supporters listed below:

- Autonomous Administration of North and East Syria Education Commission
- Bridge2Rwanda
- City of Phoenix Community Assistance Program
- Empower Farmers South Sudan
- Empower Kids - South Sudan
- Hopi Cancer Support Services
- Joan T. & S. Rex Lewis Foundation
- Kiwix
- Kwajalein Atoll Public School System, Marshall Islands
- National Comprehensive Cancer Network
- Offline Internet Consortium
- Peace Corps
- Raspberry Pi
- Voice of America - Let's Learn English Program
- WiRED International

... and our home at

ASU Arizona State University

Get involved

The ASU SolarSPELL Initiative is made possible by the contributions of donors, partners, volunteers, and our team of students, faculty and staff. We invite you to be a part of SolarSPELL's story by giving your time, leveraging your area of expertise, sharing about SolarSPELL with your networks, or making a financial contribution.

Together, we can provide communities with the information they need to solve the complex problems they face and work toward creating a sustainable, equitable future for all.

solarspell.org

team@solarspell.org