7 Applied archaeology empowers

Blending traditional and modern knowledge through educational outreach on Rapa Nui (Easter Island, Chile)

Britton L. Shepardson

Introduction

> TAO ha llegado a ser la instancia de educación más importante de la isla, después de los colegios. Es el único proyecto que ha ofrecido oportunidades excepcionales y que además se ha mantenido en el tiempo. Soy educadora y trabajé junto a TAO desde los inicios, coordinando desde el Departamento de Educación del Museo Antropológico Padre Sebastián Englert. Desde el año 2011 en adelante, he apoyado con el programa en forma voluntaria desde diversos ámbitos, así como lo hacen diversos profesionales de la isla, porque estoy convencida que instancias como TAO son lo que necesitan nuestros jóvenes para aprender, experimentar, tomar conciencia y amar su medio ambiente y su cultura. Durante todos estos años, TAO ha dejado una enorme huella en nuestros jóvenes, soy testigo de ello y ha logrado con esfuerzo trasmitirles conceptos tan importantes como la disciplina, el estudio, el respeto, el trabajo en equipo, además de la conservación y el desarrollo sostenible, temas tan relevantes en el mundo actual. TAO no es sólo una actividad de dos semanas, TAO ha llegado a convertirse en un estilo de vida, donde aprender es más entretenido y desafiante, es un programa donde todos nuestros hijos quieren estar. TAO involucra jóvenes, familias que apoyan, profesionales que ofrecen sus servicios, empresas que quieren colaborar. Todos con un objetivo común: educar con el alma, porque este tipo de educación nos hace despertar y cambia a las personas que van a cambiar el mundo.
>
> (TAO has become the most important educational institution on the island, after the schools. It is the only project of its kind that has offered unique opportunities and that has also been maintained over time. I am an educator and I have worked together with TAO from the beginning, coordinating from the Department of Education of the Padre Sebastián Englert Anthropological Museum on Rapa Nui. From 2011 onwards, I have voluntarily supported the program, as do various professionals on the island, because I am convinced that programs such as TAO are what our youth need to learn, experiment, raise awareness and love their environment and their culture. After all these years, TAO has left a huge impact on our youth. I am a witness to the many important concepts that the program has instilled in students—such as discipline, studiousness, respect, teamwork, conservation and sustainable development—concepts relevant to our modern world. TAO is not just a two-week activity, it has become a way of life for local students, where learning is more entertaining and challenging, and it's a program that all our students want to join. TAO involves young people, supportive families, professionals who offer their services, companies that want to collaborate… all with a common goal: to educate with the soul, because it's this kind of education that wakes us up and changes the people who are going to change the world.)
>
> Verónica Vergara
> Easter Island resident, mother, and business owner

Terevaka Archaeological Outreach (TAO) launched in 2003 as an exploratory initiative and as an acknowledgment that when it comes to community engagement and empowerment on Rapa Nui (Easter Island, Chile), archaeologists must do better. Today, TAO is a 501(c)(3) non-profit organization dedicated to educational outreach on Rapa Nui that continues to grow and adapt, with nearly two decades of success in uniting local island students, families, schools, government institutions, and tourism in strategic scientific, conservation, and indigenous objectives. As the most isolated inhabited island on the planet, Rapa Nui offers an extreme and powerful example of the challenges and potential for innovative forms of education that both empower local or indigenous communities and blend both traditional and modern knowledge. This chapter offers insight based on the long-term success and growth of TAO that could help foster the introduction of such programs in other Pacific Island communities and even beyond.

TAO has always worked with local Rapa Nui students between the ages of 13 and 18, and has maintained the same core mission for 17 years:

1. To offer experiential learning opportunities specific to cultural and natural resources that the surround the local community;
2. To promote awareness and expertise in conservation measures and sustainable development;
3. To document and study both cultural and natural phenomena of the past and today.

While the three primary goals of the program (education, conservation, and research) might seem commonplace in the world of anthropology, since its inception, TAO has prioritized these three goals in a manner that is far less common in the execution of archaeological projects—education comes first!

Placing education first comes from the realization that as a field, anthropological archaeology will have depressingly few remains to study in the long term if today's youth is not quickly and effectively engaged in conservation in a way that helps them understand both the fulfillment that comes from our shared cultural and natural resources thriving, and the responsibilities that fall on all of our shoulders to see to it that those same resources thrive.

Project design

While much of TAO's success has admittedly stemmed from a grueling process of trial-and-error, there have been several enlightening moments that point to elements of project design that are essential in creating an experiential learning environment that not only challenges and appeals to teenagers, but also includes a variety of stakeholders in the program. The curriculum has included yearly project topics as diverse as archaeological survey, lithic microwear analysis, lichenometry, toponymy, documentary filmmaking, renewable energy, ghost databases, hydroponic gardening, and three-dimensional orthocorrected photogrammetry (Petney et al. 2015; Rutherford et al. 2008; Shepardson 2010; Shepardson and Torres 2009; Shepardson et al. 2004; 2009; 2011; 2012; 2013; 2014; 2015; 2016; 2018; 2019; Torres and Shepardson 2005). However, all the projects are contextualized through an initial exploration of archaeological remains, data, and research.

Each year, the TAO program accepts up to 20 island teenage applicants (although TAO has also enrolled teenagers from Tahiti and mainland Chile at this point) from multiple schools on Rapa Nui—Aldea Educativa Rapa Nui and Colegio Hermano Eugenio Eyraud—to participate in a free, intensive two-week experiential learning campout. A group of local students as well as voluntary intern staff from around the US and other countries gather as relative strangers for 14 days, packed with classroom sessions, archaeological tours, guest speakers, and original field and laboratory work (Figure 7.1). They leave the program as a family—transformed.

Four aspects of project design that have helped TAO to repeatedly create transformative experiences are:

1 Teaching "axioarchaeology", not just archaeology. In order to generate buy-in from students and staff from all walks of life, family backgrounds, scholarly interests, and current or future university majors or careers, TAO curriculum acknowledges a diverse set of stakeholder ideologies by starting from a perspective of axioarchaeology (from Greek *ἀξία, axia*, "value, worth"); that is, the explicit goal of all students and staff of TAO, when it comes to interacting with cultural resources, is to study and better understand the *value* of archaeological remains. This is an effective way to initiate brainstorming sessions for new students to participate in project design, and also serves as an implicit recognition that TAO activities that involve cultural remains are based on the notion that material culture has value that goes well beyond scientific research. In some cases, projects are designed to address a variety of possible values (e.g., *mana* or spiritual, artistic, educational, scientific, familial, touristic, commercial, etc.).

Figure 7.1 TAO students at work in the MAPSE laboratory.

2 Focusing on a question about the modern world rather than the ancient world. TAO begins project design with an understanding that as soon as specific cultural and/or natural resources are deemed irrelevant or useless in the modern world, they are likely to be forgotten, consumed, or neglected. One of the goals in all TAO projects is to convince students that, whether they realize it or not, ancient cultural and natural resources are still connected to our modern, bustling, everyday lives. This point builds on our foundation of axioarchaeology, while also challenging tech-hungry teenagers to reconsider a common misperception that modern technology will serve as the panacea for our difficulties in a community quest for sustainable development.

3 "Chunking" and "spreading" intellectual material and physical activities. Projects are designed to include multiple locations, work-stations, technologies, and subject material so that all students have opportunities to explore and identify their own areas of strength and opportunities for growth. Compartmentalizing, or chunking, the project into distinct

components also helps to highlight, for students, both the responsibilities and privileges of learning through hands-on experiential activities with cultural and natural resources. Carefully designing projects to spread over a variety of different technologies and research perspectives also helps students to make connections between topics, methods, and potential careers. For example, a recent project designed to study the value of *matā* (obsidian blades) included a field component—groups of students hiking to known prehistoric stone quarries on the island with archaeologists and local guides—as well as a laboratory component. Even in the island museum's relatively small laboratory space, a group of eight students worked in pairs, periodically shifting through four different research stations. The first pair of students created artifact tags for yet uncatalogued *matā* from the museum's storage facility. They recorded the weight of each artifact using precision scales and measurements for three maximal dimensions of each artifact using digital calipers. The second pair of students used USB microscopes and tablets to capture digital images of the blade edges for the sake of microscopic use-wear analyses (Figure 7.1). The third pair of students used a DSLR camera to acquire multiple digital photographs of each artifact as a whole. And the final pair of students worked at a laptop to enter each artifact's new, unique catalogue number, weight, dimensions, microscopic photograph filenames, and digital photograph filenames into a comprehensive database. They then placed each individual *matā* and artifact tag in an individually labeled bag for safer storage in the museum. The chunking and spreading in the laboratory meant that all students were mastering a relatively small and different skillset at each station. In the process, they were also working with methods and technologies that could be applied to any number of career interests.

4 Maximizing available resources. Creating an outstanding two-week educational experience for students can be done relatively easily with a massive budget. Creating an outstanding educational experience for students every year for nearly two decades is a different challenge altogether. Research and/or conservation equipment alone can be pricey. Creating an intensive experiential campout for 25 students and staff—which has also become a key for transformative experiences by removing cell phones and other ordinary, daily distractions from teenagers' lives—requires strategic collaboration. TAO projects are regularly designed to have library and laboratory components, and even more, to contribute to the mission of the island's only museum, the Museo Antropológico Padre Sebastián Englert (MAPSE, *www.museorapanui.gob.cl*). And in exchange, the museum graciously provides access to workspaces, archived documents, and archaeological collections. Ma'u Henua Polynesian Indigenous Community, the island organization charged with administering the Rapa Nui National Park (which covers more than 40% of the island's total area), generously coordinates open access to archaeological sites for TAO staff and students with no entry fees.

And perhaps the most critical partnership that TAO has established has been the one with Hotel Explora (*www.explora.com*). Lodging, food, and beverages for a yearly two-week campout of 25 students and staff for TAO on Rapa Nui could be a prohibitively expensive obstacle in operations if it were not for the strategic planning between TAO and Explora. By coordinating TAO's projects with Explora's low season, Explora has been able to provide not only an area for camping, but also three meals per day, access to staff bathrooms, and occasional use of hotel vans for student field trips. That is, together TAO and Explora have identified resources to bolster TAO's operations that would likely sit idle during the island's winter months (and the hotel's low season) otherwise.

Furthermore, many of Explora's employees, who have become familiar with TAO's goals and accomplishments, have begun to donate additional working hours to help realize a shared vision in creating unforgettable educational experiences for the island's youth. The willingness for Explora and TAO to explore an innovative and a mutually beneficial relationship allows Explora to engage, at only moderate costs, in community philanthropy with exceptional returns. Explora and TAO are currently devising plans to extend this operational synergy to launch sister outreach programs at other hotel locations in Chile and Peru.

Three-project examples

Orchestrating projects and curriculum that not only combine TAO's three-part mission statement, but also begin with axioarchaeology, focus on a modern question, effectively chunk and spread activities, and maximize resources is an acquired skill. Curriculum development requires extensive planning and communication with partnering institutions, international researchers, local experts, and prospective students.

TAO creates an empowering educational environment by beginning every project with open discussions with students regarding archaeological remains, traditional lifeways, and the evolution of human-environment relationships. This process leads to students better understanding the value of cultural and natural resources, imagining critical new careers for the community's sustainable development, and instilling a new level of consciousness in conservation (regardless of students' career choices).

Energy project

The first example of a highly successful and innovative project began with the question: is the current production and consumption of energy on Rapa Nui sustainable? At the outset, most students had no idea how electricity on

the island was generated to support their daily lives. And to contextualize this problem, the curriculum began with archaeologists' long-standing interests in prehistoric energy investment in *moai* (statuary) and other forms of monumental architecture (e.g., *ahu* or massive stone platforms, *hare paenga* or boat-shaped stone houses, etc.). Conclusions drawn regarding the abundance of monumental architecture developed throughout Rapa Nui's (and other Pacific Islands') prehistory drew attention to both the tremendous amount of energy that would have been expended in the process (e.g., Goldman 1955; Sahlins 1955; 1958) as well as the broader social and biological impacts of such energy investment (Graves and Ladefoged 1995; Graves and Sweeney 1993; Hunt and Lipo 2001; Kirch 1990; Mulloy and Figueroa 1978; Shepardson 2006; Stevenson 1986).

After the introduction to archaeological inquiry into energy investment in prehistoric monumental architecture, TAO students were challenged to develop their own energy requirement estimates, for example, of carving, transporting, and erecting multi-ton *moai* on the island (Figure 7.2). Their various approaches to quantitative estimates involved algebra, geometry, spreadsheets, and references to other experts' attempts to do the same (e.g., Einstein 2006; Lee 1998; 1999; Love 1990; MacIntyre 1999; Mulloy 1970; Pavel 1990; 1995; Shepardson 2006; 2013; Van Tilburg 1994). An introduction to three-dimensional orthocorrected photogrammetry technology and related software allowed TAO students, in some ways, to improve upon previous estimates for energy expenditure by calculating extremely precise measures for statue volume (Figure 7.3).

Figure 7.2 TAO students attending a field lecture regarding statue construction and transport by TAO Founder and Director Britton Shepardson.

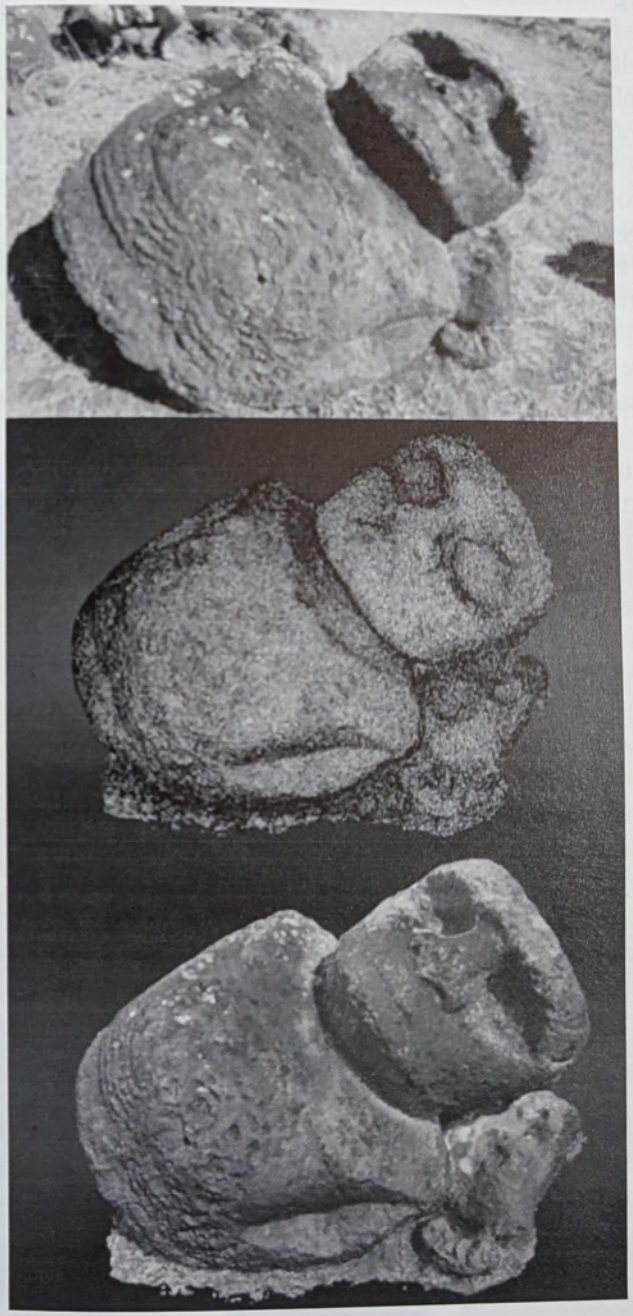

Figure 7.3 Basalt moai, digital wireframe model, and final 3D digital rendering created by TAO students through orthocorrected photogrammetry to help estimate statue volume.

Following introductory sessions regarding the prehistoric context to the energy question, students traveled to the island's power plant, run by Sociedad Agrícola y Servicios Isla de Pascua Limitada (SASIPA, *www.sasipa.cl*), where the plant's operators gave the students a tour of the facility's diesel generators and data to estimate how much energy is being consumed by the island's modern residents (Petney et al. 2015). Comparative analyses of energy consumption in prehistoric activities and modern activities promoted lively discussions amongst TAO students regarding the benefits and drawbacks of both ancient technology and modern technology. Students concluded rather quickly however that the island's current production and consumption of energy on Rapa Nui clearly was not sustainable (especially since all the diesel that fuels the SASIPA power plant must arrive to the island on massive, trans-Pacific tankers, whose voyage lasts over a week to complete).

Their own conclusions drove the subsequent exploration of alternative, renewable energy sources on the island. Students reviewed the concept of solar-powered energy, created copper-and-magnet hand crank generators to light a small LED bulb, wired an old bicycle frame to an electric scooter motor (both recovered from the island's landfill) to power an electric blender, and eventually created a wind-powered turbine from repurposed materials (also collected from the island's landfill).

In sum, the multi-faceted energy project encouraged students to arrive at their own conclusions about the modern, non-sustainable approach to energy production and consumption on the island, to compare it with manual labor methods from prehistoric times, and to posit "intermediate" forms of technology that might serve the island community well in the future. Along the way, they honed their skills in archaeology, mathematics, computing, engineering, physics, anemology, and digital photography. Their work also took them to archaeological sites, the power plant, the local museum, and the island's landfill for research purposes.

Toponymy project

The second project example was based on a growing concern on the island that place names on the island and the origin of those names could soon be lost if measures are not taken to seek old local knowledge and oral tradition, develop a database, and provide a comparative framework for differing accounts of place names that often exist between different people and different generations.

The project was contextualized through an exploration of archived materials at the MAPSE library, ranging back to island toponymic data from sources such as Duque (1982), Charlin (1947), and even Thomson's (1889) island-wide survey of *ahu*. While conducting library research regarding Rapa Nui toponymy, students also studied relevant oral tradition and mapping technology that likely existed during different time periods on the island.

They proceeded to weigh the benefits and drawbacks of a multi-generational oral record-keeping system that existed on most Polynesian islands throughout prehistoric times. And eventually, TAO students developed an interactive web database concept that would help ensure that place names and associated oral tradition (even varying versions of information from different sources) could be crowd-sourced, recorded, and edited for future generations (Figure 7.4). Students and staff created a 14-category system for place types and transcribed more than 500 place names for the island from library resources to launch the publicly accessible database. The website that hosts the toponymic database (*www.terevaka.net/toponymy*) was created using a combination of HTML, JavaScript, Google Maps API, and XML languages.

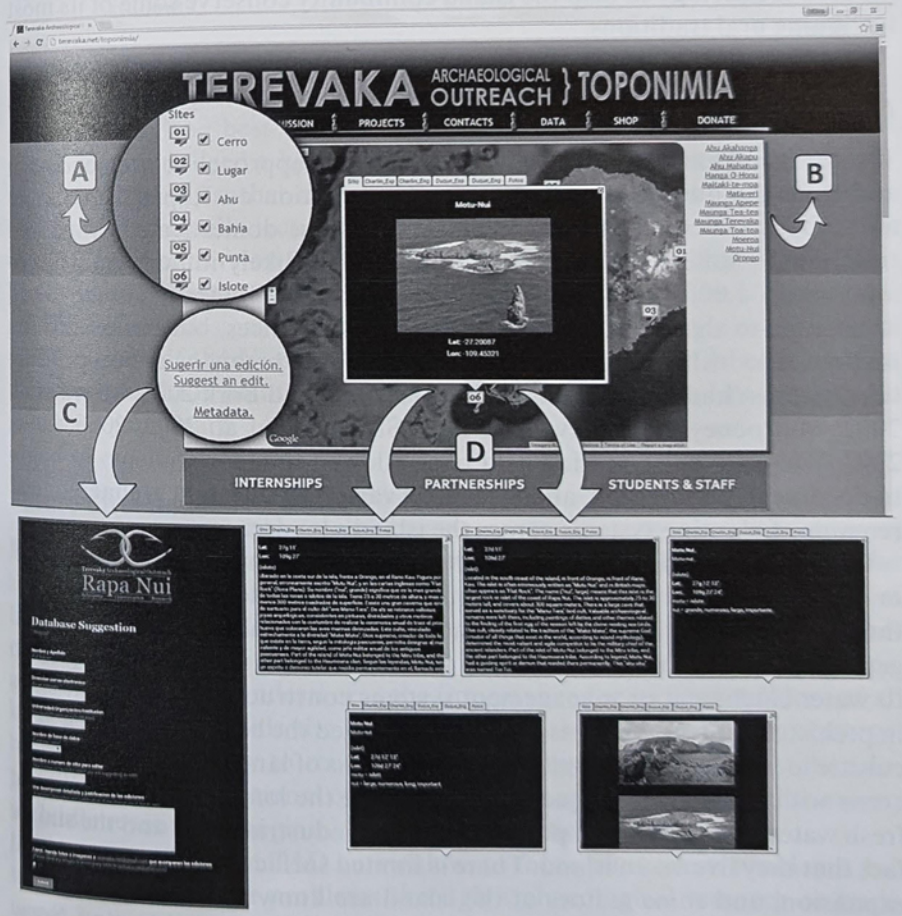

Figure 7.4 Web interface for publicly accessible interactive toponymy database of Rapa Nui designed by TAO students.

Finally, as some students continued to compile information for the digital database, other students began a long process of "ground-truthing" places from the database by hiking to locations, marking precise latitude and longitude coordinates, and recording digital photos of places and archaeological remains (or natural landscape features) of interest.

The toponymy project produced the foundation for a database that will take years to complete and will likely provide opportunities for additional fieldwork and library work for TAO students and staff for many seasons to come. However, even in its initial stages, the project has motivated students to explore the island landscape, the place names, and the stories that go with some of these names. The work also provided introductory lessons in cartography, global positioning system (GPS), digital photography, library research, relational databases, and web-programming. And the result of their hard work is a web concept that demonstrates real potential to apply modern technology to help the island community conserve some of its most intriguing oral traditions.

Food production project

The third and final example of TAO's innovative approach to project design addresses the question: is modern food production on Rapa Nui sustainable? TAO students began by learning about the domesticated crops and traditional planting techniques that Polynesians likely imported to the island nearly 1,000 years ago (Shepardson et al. 2008). Many students had knowledge to share from their own family experiences, but brainstorming sessions also included archaeological research on prehistoric food production systems (Ladefoged et al. 2005; 2010; Mieth and Bork 2003; Mieth et al. 2002; Mulrooney 2012; Stevenson 1997; Stevenson et al. 2002; 2005; 2006; 2007; Wozniak 2001). Hiking field trips allowed time for students to begin to document, photograph, and measure a variety of different archaeological remains of planting systems across the island's landscape.

Organized discussions highlighted some of the strong points of traditional or ancient approaches to food production on the island: a selection of crops that is particularly well suited to the sometimes challenging climatic and geological conditions on the island, and a seemingly meticulous approach to water catchment or management systems constructed from basalt slabs in prehistoric times. Students also acknowledged the benefit of modern agriculture in its intensive output over broad swaths of land. Their primary concerns with modern techniques, however, were the long-term availability of fresh water for agricultural production on an industrial scale and the simple fact that they live on an island. There is limited surface area for agricultural expansion, and some sectors of the island are known to offer disappointingly little in terms of the soil nutrients necessary for crop production. Some students were also quick to acknowledge that converting land to modern

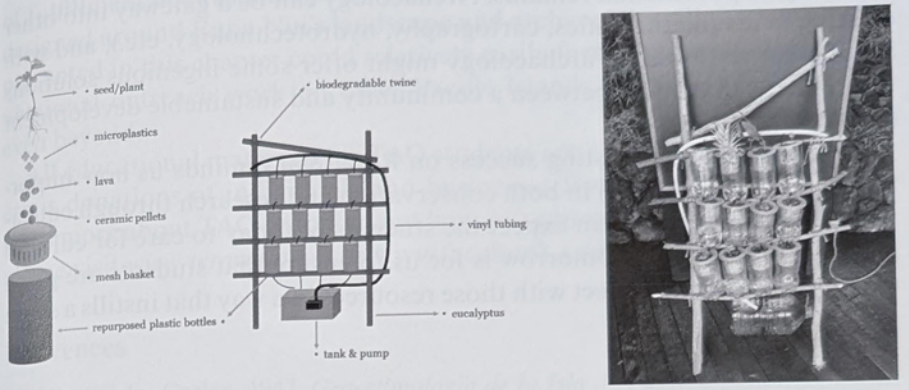

Figure 7.5 Vertical hydroponic garden schematic and prototype created by TAO students.

agricultural production almost always results in the bulldozing or destruction of archaeological resources on private property.

Considering the best of both worlds, traditional and modern, student teams conceptualized a hybrid production system, recycling water and expanding vertically rather than horizontally. Within a week, student teams had employed small electrical pumps and repurposed materials from the island landfill to develop functioning prototypes of vertical hydroponic gardens (Figure 7.5). Once students had passed through stages of library research, concept design, engineering, and hydroponics, they also visited the plant nursery of the National Forestry Corporation of Chile on the island to receive donation plants and seeds that would give the student hydroponic gardens a jumpstart!

Future directions

The growth and evolution of TAO over the course of 17 years has been far from perfect. However, the sustained livelihood of the program offers proof that untapped opportunities for educational programs and applied archaeology still exist within Pacific Island communities and beyond. Perhaps, above all else, TAO underscores the importance for us (stakeholders of all kinds) to think "outside the box". Opportunities will continue to emerge, but we must be ready to recognize them in any form (e.g., an archaeologist running an educational outreach program and a luxury travel company with idle resources imagining a mutually beneficial relationship).

The commitment in TAO curriculum to focus on modern problems, but to contextualize these problems through archaeological research or traditional knowledge, also highlights the importance of blending ancient with modern. Archaeology research does not need to be exclusively dedicated to

the study of past human remains. Archaeology can be a gateway into other exciting fields (mathematics, cartography, hydrotechnology, etc.), and with some creative thinking, archaeology might offer some ingenious solutions to problems that stand between a community and sustainable development (Table 7.1).

And finally, TAO's lasting success on Rapa Nui reminds us how important it is to engage youth in both conservation and research through education. The only way we can expect the students of today to care for cultural and natural resources tomorrow is for us to ensure that students are given the opportunity to connect with those resources in a way that instills a sense

Table 7.1 A summary of the diversity of topics and stakeholders involved through three innovative project designs of TAO

	Energy project	*Toponymy project*	*Food production project*
Career skills	1 Algebra 2 Geometry 3 Engineering 4 Photography 5 Mapping 6 Databases 7 Anemology	1 Archival research 2 Databases 3 Mapping 4 Photography 5 Web programming 6 Crowd-sourcing information	1 Archival research 2 Agriculture 3 Hydrotechnology 4 Photography 5 Databases 6 Mapping
Technology	1 Spreadsheets (Microsoft Excel) 2 DSLR camera 3 Three-dimensional orthocorrected photogrammetry (Agisoft Metashape) 4 Geographic information systems 5 Solar panels 6 Electromagnetic induction 7 Wind turbines	1 Spreadsheets (Microsoft Excel) 2 DSLR camera 3 GPS 4 Geographic information systems 5 HTML, Javascript, Google Maps API, XML 6 Google forms	1 Spreadsheets (Microsoft Excel) 2 DSLR camera 3 GPS 4 Geographic information systems 5 Hydroponic pumps
Collaborators	1 Hotel Explora 2 MAPSE 3 SASIPA 4 Ma'u Henua 5 Aldea Educativa Rapa Nui 6 Colegio Hermano Eugenio Eyraud	1 Hotel Explora 2 MAPSE 3 Biblioteca William Mulloy 4 Ma'u Henua 5 Aldea Educativa Rapa Nui 6 Colegio Hermano Eugenio Eyraud	1 Hotel Explora 2 MAPSE 3 Biblioteca William Mulloy 4 Ma'u Henua 5 Aldea Educativa Rapa Nui 6 Colegio Hermano Eugenio Eyraud

of fulfillment *and* responsibility. While the projects designed for TAO were designed around Rapa Nui's landscape and archaeology, all three examples presented in this chapter could relatively easily form the curriculum for educational outreach work on other Pacific Islands, elsewhere in Asia, and even beyond.

All educational materials for TAO students are purchased thanks to generous donations of individuals and businesses from around the globe. To learn more about TAO or to find out how you can support the work of TAO, please visit *www.terevaka.net* or www.facebook.com/TAOrapanui.

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