Islands of Innovation: **A Visit to Galápagos Shapes Global STEAM Initiatives**

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El Dr.Adam Scribner, autor de este artículo, es director de Iniciativas de Educación STEM en la Facultad de Educación de la Universidad de Indiana, donde desarrolla experiencias de enseñanza y aprendizaje STEM diseñadas para fomentar la próxima generación de científicos, ingenieros, creadores e innovadores. En los últimos ocho años ha ejercido como investigador principal o coinvestigador principal de 38 proyectos financiados con subvenciones por un total de más de 4,9 millones de dólares para promover la educación STEM en Indiana y otros lugares.

Esto incluye proyectos relacionados con inteligencia artificial, investigación oncológica, robótica submarina e ingeniería climática, así como proyectos de colaboración internacional en Ankara, Bangkok, Berlín y las Islas Galápagos. Actualmente es coinvestigador principal del proyecto Educating Environmental Change (EfEC).

Les invitamos a su lectura en inglés.

Implementing Global STEAM (Science, Technology, Engineering, Arts, and Mathematics) initiatives in schools can help prepare students to thrive in an interconnected world. Global STEAM programs cultivate creativity, collaboration, and problem-solving skills that are vital for success in the global workforce.

By integrating disciplines and connecting students across cultures, Global STEAM initiatives foster cross-cultural understanding and equip learners to address shared challenges such as climate change and sustainability.

They also promote equity by expanding access to high-quality learning opportunities and inspiring underrepresented students to pursue STEAM careers. Ultimately, Global STEAM education empowers students to see themselves as active and creative problem solvers for a more equitable and sustainable future.

When I develop Global STEAM initiatives, I start by aligning STEAM disciplines – usually science and engineering– with the United Nations' Sustainable Development Goals (UN SDGs). For example, because much of my work focuses on helping educators teach the science and policy of climate change, many of the STEAM lessons that I develop align with the UN SDG "climate action".

Although these may seem at first glance to be global political goals rather than educational targets, The UN SDGs provide critical support for Global STEAM lessons because they enable students to collaborate and engage in all four of the domains of global competence, as defined by the Organization for Economic Co-operation and Development (OECD) and the Asia Society.
The four domains are (1) *investigating the world, (2) recognizing perspectives, (3) communicating ideas, and (4) taking action.* These domains promote inquiry and can act as a guide for structuring curriculum and instruction that promotes global competence (Asia Society, 2018).

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Global STEAM in the Galápagos Islands

In February 2024, I had the good fortune to travel with my colleagues Dr. Michael Hamburger, Professor, Indiana University's (IU) Department of Earth & Atmospheric Sciences, and Ms. Molly Fisher, Director of IU's Mexico Gateway, to the Galápagos Islands, Ecuador.

Our visit included meeting and collaborating with Dr. Karla Diaz, Professor, College of Social Sciences and Humanities, and other faculty and administrators from Universidad San Francisco de Quito (USFQ).

We also met with researchers from USFQ's Galápagos Science Center and the Charles Darwin Research Station as well as teachers and administrators from the Tomas de Berlanga (TdB) School on Santa Cruz Island, Galápagos.

Our trip centered on a collaborative three-day professional development workshop for TdB teachers in collaboration with USFQ's School of Education. TdB is a private, bilingual, international K12 school supported by USFQ's School of Education, and a leader in teacher professional development for schools across the Galápagos Islands.

One of the many things that drew me to this international collaborative project was TdB's strong emphasis on interdisciplinary learning with a focus on conservation and global citizenship, as well as their new STEAM program –all priorities that align well with my education initiatives and research.

Our workshops with TdB teachers allowed us to get to know the school and its students and to provide pedagogical and topical sessions on environmental science and policy, similar to workshops that Dr. Hamburger and I facilitate for the Educating for Environmental Change (EfEC) project. EfEC is project that connects IU climate scientists and K12 teachers from the US Midwest to develop new and innovative ways to teach the science and policy of climate change.

This trip also provided us with the opportunity to learn from TdB teachers and students about the unique characteristics of the Galápagos islands, an iconic living laboratory for studying biodiversity, evolution, and sustainability.

IU is located in the "heartland" of the US Midwest, so the educators that we primarily work with serve in schools far from seacoasts, glaciers, deserts, or other areas more directly impacted by climate change.

TdB teachers investigating a model ice core and making inferences.

With that in mind, we planned this trip to lay a foundation for future connections between the teachers that we work with and the educators who teach at TdB, so that they can learn from one another.
Specifically, we wanted to plan projects that would ultimately connect US teachers with TdB teachers so that they can learn firsthand how climate-driven issues are impacting vulnerable ecosystems like the Galápagos Islands.

These issues that we hoped to emphasize included climate change and shifting ecosystems, biodiversity loss, invasive species, resource management, and sustainability.
In addition to these critical scientific issues, we also hoped to help cultivate teachers', and their students', social and cultural perspectives including learning different languages (Spanish and English) and customs (Ecuadorian and US), and fostering creative, different, and potentially cross-cultural ways of thinking.

One goal of these lessons will be to task students to collect data from their local environments and share their data and inferences (made from the data) with teachers and students in their sister schools.

Throughout our three-day workshop at TdB, we facilitated numerous lessons and activities designed for the EfEC project that included: engineering design and the integration of the engineering design process; lessons pertaining to the causes, consequences, and potential solutions to climate change (including lessons on natural disasters, greenhouse gases, ice cores and other proxy data, and discussions about environmental

justice); field-based observation and interpretation exercises; and creative design thinking activities in which the participating teachers worked collaboratively to sketch their own solutions to local environmental issues, such as cleaning up plastics in marine environments.

During the workshop, we introduced how microcontrollers can be integrated into Global STEAM programs. Microcontrollers are unique devices that can be designed and programmed by students to collect and share data around the world.

For example, we helped TdB teachers set up and install a "Raspberry Shake" educational seismograph that is made from a Raspberry Pi internet-ready microcontroller. The Raspberry Shake that we provided to TdB uses a sophisticated, low-cost geophone sensor that allows schools around the world to monitor seismic activity throughout the Galápagos Islands, directly from its TdB classroom location.

Planning for Future Global STEAM Initiatives

Plans for future Global STEAM initiatives between the Galápagos and US educators are currently underway. They include creating "sister schools" in the US for TdB (and potentially other schools on the Galápagos Islands) that will pair TdB science teachers with US science teachers who have participated in the EfEC project. One exciting result of our exploratory Galápagos project was inviting two teachers from TdB to join us for a week-long EfEC summer teacher professional development institute in Bloomington, IN USA, in May 2024.

During the institute, the participating Galápagos teachers collaborated with Indiana K12 science teachers and IU climate scientists on numerous "climate action" projects. Future plans also include online co-design sessions with the participating teachers and IU scientists to develop innovative online collaborative lessons that will link US and Galápagos classrooms.

One goal of these lessons will be to task students to collect data from their local environments and share their data and inferences (made from the data) with teachers and students in their sister schools. In doing so, they will be i*nvestigating the world and communicating ideas,* domains of global competence. This includes having students learn about cultural differences of students in their sister schools, learn about their different local environments (i.e., flora, fauna, geography and geology) and having students overcome any potential language barriers.

Through these lessons, they will also be *recognizing perspectives,* another domain of global competence.

Our proposed future Global STEAM lessons will also incorporate other low-cost microcontroller devices similar to the Raspberry Shake. These may include Microbits, Arduinos, and/or Raspberry Pis. These devices can be coupled with various "internet of things" sensors to collect interesting and important scientific data based on what the participating science teachers are teaching and what the students choose to investigate.

These and similar Global STEAM initiatives have the potential to empower students to take action, by investigating their natural world, sharing their findings with other others around the world, and coming up with their own creative and innovative solutions.

Examples of the types of sensors that can be coupled with microcontrollers include visible light, infrared light, soil moisture, water level, pH, sound, and more. And because microcontrollers can be connected to the internet, they can be programmed to share local data with any teacher or school with an internet connection.

Examples of potential Global STEAM microcontroller projects include: (1) having students use CO2 sensors to monitor CO2 fluxes and having students choose where to place the devices; (2) building networks of Raspberry Shakes, placed around the US and Galápagos Islands, and having students decide how they should be monitored; (3) using sound sensors with microcontrollers to record bird calls to help surveil local bird populations (potentially including Galápagos finches, northern cardinals, or endangered bird species); and (4) implementing capstone projects that task students to determine what sensors they should use to learn more about local and global environmental issues, potentially coming up with unique ideas like this one, and sharing their ideas with their sister schools.

Ultimately, these and similar Global STEAM initiatives have the potential to empower students to take action (the fourth domain of global competence), by investigating their natural world, sharing their findings with other others around the world, and coming up with their own creative and innovative solutions to important global environmental issues–including anthropogenic climate change.

In time, it is my hope that these projects will help foster the next generation of informed citizens and future scientists; a generation that will understand the importance of protecting our planet's unique and irreplaceable environments, like Galápagos.