

International Collaboration in Science and Mathematics Education: Two Exemplars in Practice

Sarah Quebec Fuentes
Texas Christian University

Mark A. Bloom
Dallas Baptist University

In the previous editorial, the first in a series, we expressed ICRSME and *EJRSME*'s commitment to promoting genuine, international collaboration to advance science and mathematics education ([Quebec Fuentes & Bloom, 2020](#)). In particular, we framed such collaboration with the construct of *communities of practice*, "groups of people who share a concern, set of problems, or passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (Wenger et al., 2002, p. 4). For a community of practice to establish a *shared goal* (Clausen et al., 2009, Quebec Fuentes & Spice, 2017) and engage in the *co-construction of knowledge* (Palinscar et al., 1998, Sim, 2010), its members must navigate and learn from conflict, institute means of communication, and build trust. We also identified some of the challenges and opportunities communities may encounter when engaging in such work, some unique to international collaboration, and closed with a set of questions to guide regular reflection.

In line with the aforementioned commitment, the theme of the ICRSME 2022 Virtual Conference was *International Collaboration in Science and Mathematics Education*. The conference highlighted collaborative, international work through two plenary presentations:

- *A Model Institute for Innovation in Research & Education*
Dr. Marisín Pecchio, Instituto de Investigaciones Científicas y Servicios de Alta Tecnología de Panamá (INDICASAT-AIP)
- *Lessons Learned from Collaborative Place-Based Learning Programs in Yucatán, Mexico and Belize*
Dr. Grace Bascopé, Botanical Research Institute of Texas (BRIT) and Maya Research Program

In what follows, we describe the nature and intricacies of this work in the context of communities of practice and their attributes. Our hope is that we can learn from these two exemplars as we move forward with our goal of fostering genuine, international collaboration.

INDICASAT-AIP

Dr. Marisín Pecchio is a research scientist at [INDICASAT-AIP](#). She received her bachelor's degree in Pharmacy from the University of Panamá and her Doctoral degree in Pharmacy from the University of Navarro in Spain. Dr. Pecchio's research interests involve the discovery of drugs from natural products; examinations of the effects of bioactive compounds; and novel delivery systems for drugs. In addition to her research, one of her roles at INDICASAT-AIP is Coordinator of the Center for Academic Affairs and Collaboration, for which she directs the design, development, implementation, coordination, and supervision of academic and research training programs.

2 QUEBEC FUENTES & BLOOM

INDICASAT-AIP was founded in 2002 by la Secretaría Nacional de Ciencia, Tecnología e Innovación de Panamá ([SENACYT](#)) with the aim of supporting the economic and sociocultural development of Panamá through scientific research. Specifically, la misión de INDICASAT-AIP is:

establecerse como una plataforma para el avance científico y tecnológico de Panamá, contribuyendo a la formación de recursos humanos de excelencia en investigación – desarrollo aplicado a la diferentes disciplinas prioritarias para el avance del país.
(INDICASAT-AIP, 2020)

La visión de INDICASAT-AIP is to establish the Institute as *un centro de excelencia* with a national and international reputation in biomedical research and technology services and with the role as a hub for knowledge transfer to other (especially Latin American) countries (INDCASAT-AIP, 2020). In line with esta visión, INDICASAT-AIP has four main objectives: (1) recruiting top-tier scientists; (2) conducting collaborative (national and international), interdisciplinary biomedical research; (3) offering professional development and academic activities that foster una cultura científica; and (4) supporting socio-economic development through services and knowledge dissemination.

In her plenary presentation, Dr. Pecchio shared the INDICASAT-AIP activities that meet the aforementioned objectives. INDICASAT-AIP has multiple centers through which research is conducted (e.g., Center for Biodiversity and Drug Discovery and Neuroscience Center), the communication of knowledge generated is facilitated (Center for Innovation and Technology Transfer), and academic activities are coordinated (Center for Academic Affairs and Collaboration). Currently, 30 scientists are conducting research in a variety of areas, including the treatment of malaria, tissue engineering, and a response to COVID-19. The work of the scientists has been documented through more than 400 published papers, patents, and the hosting of an international conference on biomedical and interdisciplinary research. INDICASAT-AIP also has several doctoral programs, provides opportunities for undergraduate and master's student research, and conducts academic programming for K-12 students.

An examination of the complex and multifaceted work of INDICASAT-AIP through the lens of collaboration reveals the characteristics of a community of practice (Wenger et al., 2002). INDICASAT-AIP is a *community of people* who care about the *domain* of scientific research for the betterment of local, national, and international communities. Further, through the various programs, INDICASAT-AIP is developing a *shared practice* that revolves around conducting, sharing the findings of, and introducing K-12 students to scientific research.

INDICASAT-AIP also exemplifies two foundational components of communities of practice, namely a shared goal (Clausen et al., 2009) and the co-construction of knowledge (Palinscar et al., 1998; Sim, 2010). The interdisciplinary nature of the scientific research conducted at INDICASAT-AIP involves the contributions of persons with diverse areas of expertise. For instance, the Center for Biodiversity and Drug Discovery focuses on the development of drugs through the identification of molecules from the marine biodiversity of Panamá (INDICASAT-AIP, 2020). This work is conducted by scientists from various fields, such as organic chemistry, biomedicine, ecology, and bioengineering. Additionally, the research, development, and commercialization of the drugs requires the collaboration between higher education, governments, and industry (INDICASAT-AIP, 2020).

Through its aforementioned misión y visión, INDICASAT-AIP has a shared goal to contribute to the socio-economic development of Panamá and other countries via scientific research. This *shared but given goal* permeates the work of INDICASAT-AIP. However, the various INDICASAT-AIP activities additionally establish a *shared beyond given goal* that falls under the umbrella of the shared but given goal but also centers on a specific area of need through a mutually established endeavor (Quebec Fuentes & Spice, 2017). For example, as previously described, the Center for

Biodiversity and Drug Discovery investigates the local marine biodiversity for its potential in drug development.

Further, the Center for Academic Affairs and Collaboration strives to establish and maintain a pipeline of research scientists through programming across various populations. At the doctoral level, INDICASAT-AIP in collaboration with Acharya Nagarjuna University in India created a PhD program in Biotechnology, the first of its kind in Panamá. In partnership with a multitude of national and international universities, INDICASAT-AIP provides the infrastructure and opportunity for undergraduate and master's student research. The Student Research Innovation Program invites secondary school students to propose research projects that they conduct with the support of one of their teachers and a scientist from INDICASAT-AIP. For another program, scientists or doctoral students visit a school and engage students in problem solving about a scientific issue in the local community. As demonstrated, INDICASAT-AIP has built local, national, and international communities centered on science research through its partnerships and collaborations.

Maya Research Program

Dr. Grace Bascope is an ethno-environmental medical anthropologist, who taught for many years at Texas Christian University and the University of North Texas. Dr. Bascope holds a Bachelor of Arts degree from Baylor University, a Master of Science in Social work from the University of Texas, and a PhD in Medical Anthropology from Southern Methodist University. She is currently a Resident Research Associate at the [Botanical Research Institute of Texas](#) (BRIT) in Fort Worth, Texas and leads field research and education initiatives for the [Maya Research Program](#) (MRP), which is affiliated with the University of Texas at Tyler.

The MRP is a non-profit organization that leads ethnographic and archaeological research throughout Middle America. Over the past 30 years, more than 3000 students and volunteers have partnered with MRP to document and protect ancient Maya sites and attend to the needs of local communities. Two key goals of the MRP are to:

- Conduct research that helps us better understand the complex ancient societies of the Americas, and
- Encourage the participation of students and volunteers – anyone who wants to experience the real world of archaeological or anthropological research and understand how we learn about other cultures. (Maya Research Program, n.d.)

Participants in the MRP have come from the United States, Australia, Canada, Europe, Latin America, and Japan and have ranged in age from 18 to 80. Dr. Bascope's major MRP initiatives center around collaborative, place-based learning programs in the village of Yaxunah, Yucatán, Mexico and in northwestern Belize. In her plenary talk, Dr. Bascope shared one of the major MRP initiatives - *Yaxunah Ethnographic Project*.

For over 30 years, Dr. Bascope has been working with the village of Yaxunah, which is a small Yucatec Maya community (population approximately 600) in the state of Yucatán, Mexico. In the early years, Dr. Bascope was involved as an ethnographer studying the ancient Maya city adjacent to the village. In later years, she led ethnographic and ethno-botanical field schools. Through these experiences, Dr. Bascope learned the importance, especially in such a small group of people, of carefully attending to the societal norms, values, and needs of those with whom you collaborate. Figure 1, from her plenary talk, depicts a typical village meeting where MRP participants and community members discuss goals of the partnership and expectations of all parties to build productive collaboration. Such village meetings include questions such as:

- What is inbounds and what is off limits for visiting students/volunteers?
- What projects might be helpful/meaningful to community members?
- What empirically trained village experts (defined as having learned by doing; think indigenous knowledge) might be available to participate in instruction?
- What local members might benefit from participating as students in the field school experience?
- Who in the community might be available to mentor students' projects? ([Bascopé, 2022](#))

Meetings like these were a means of *communication* to establish *trust* and to frame *conflict* as an ongoing process that results in mutual learning (Achinstein, 2002, p. 425) and resulted in successful, authentic collaboration.

For one such example of an ethnographic and botanical school experience in the Yucatan, participants were tasked with building a reference collection of local plants for the Yucatan State Herbarium. The members of the community of practice included students who were taking a class for college credit, members of the Yaxunah village (including those with deep indigenous knowledge), research scientists, and volunteers. Additionally, members ranged in their field experience and botanical knowledge from novice to expert. Locals were familiar with the native wildlife, could identify potentially harmful plants and animals, and knew about dangerous features of the landscape; non-local members had much to learn. This diverse and *distributed expertise* allowed for the knowledge development of the collective.

Figure 1

Meeting with the Members of Yaxunah Community



Part of this educative process included establishing a *shared practice*, both at a surface and at a deeper level. Among the members of the community were some who spoke only Yucatec Mayan, only English, Spanish and English, Spanish and Mayan; only one individual spoke all three languages. Despite such language barriers, the members found a means of effectively communicating amongst themselves. However, this shared practice extends to “a set of frameworks, ideas, tools, information, styles, language, stories, and documents that community members share ... and enables the community to proceed efficiently in dealing with its domain” (Wenger et al., 2002, p. 29), as evidenced

in the present example. While the shared beyond given goal of creating a botanical collection was achieved, so much was gained by members of the community, including the development of botanical collecting skills among novices and the documentation of indigenous medical and ethnographic knowledge of local plants used for medicine (to treat a variety of diseases) and for rainfall prediction (for agricultural purposes). Through purposeful communication to navigate conflict and build trust, the community established genuine and effective collaboration and cooperation.

Conclusion

The work of INDICASAT-AIP and MRP both demonstrate the attributes and factors that support the formation of communities of practice (e.g., shared goal, co-construction of knowledge, communication, conflict, and trust). Further, the shared practice of each indicates that members of the community actively mediated the *border politics*; that is, negotiated “the bounds of membership and beliefs of a given community” (Achinstein, 2002, p. 426). In particular, the members contemplated who was included in the community, how various members were included, how and whose knowledge contributed to and is represented in the collective work, and who are the beneficiaries of the collaboration (Atweh & Keitel, 2007). These two exemplars of genuine, international collaborations provide us with considerations as we embark on such work within the domain of science and mathematics education.

References

- Achinstein, B. (2002). Conflict amid community: The micropolitics of teacher collaboration. *Teachers College Record*, 104(3), 421-455.
- Atweh, B., & Keitel, C. (2007). Social (in)justice and international collaborations in mathematics education. In B. Atweh, A. Calabrese Barton, M. C. Borba, N. Gough, C. Keitel, C. VistroYu, & R. Vithal (Eds.), *Internationalisation and globalisation in mathematics and science education* (pp. 95-111). Springer.
- Bascopé, G. (2022, March 12). *Lessons learned from collaborative place-based learning programs in Yucatán, Mexico and Belize* [Conference Session]. International Consortium for Research in Science & Mathematics Education Virtual Conference. <https://icrsme.com/2022-plenary>
- Clausen, K. W., Aquino, A., & Wideman, R. (2009). Bridging the real and ideal: A comparison between learning community characteristics and a school-based case study. *Teaching and Teacher Education*, 25(3), 444-452.
- INDICASAT-AIP. (2020). *Instituto de Investigaciones Científicas y Servicios de Alta Tecnología de Panamá*. <https://indicat.org.pa/>
- MRP. (n.d.). *Maya Research Program*. Retrieved April 28, 2022, from <http://www.mayaresearchprogram.org/>
- Palinscar, A. S., Magnusson, S. J., Marano, N., Ford, D., & Brown, N. (1998). Designing a community of practice: Principles and practices of the GISML community. *Teaching and Teacher Education*, 14(1), 5-19.
- Quebec Fuentes, S. & Bloom, M. A. (2020). International collaboration in science and mathematics education. *Electronic Journal for Research in Science & Mathematics Education*, 24(4), 1-5.
- Quebec Fuentes, S., & Spice, L. (2017). Fostering collaboration and the co-construction of knowledge: A multidimensional perspective. In M. Boston, & L. West (Eds.), *Reflective and collaborative processes to improve mathematics teaching* (pp. 307-316). NCTM.
- Sim, C. (2010). Sustaining productive collaboration between faculties and schools. *Australian Journal of Teacher Education*, 25(5), 18-28.
- Wenger, E., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice: A practical guide to managing knowledge*. Harvard Business School Press.