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Author(s)	Tricia Seow, Irvine Kim and Julian Chang

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The Sustainability Learning Lab: Enhancing Geographical Inquiry in the Field and Classrooms

By *Tricia Seow, Kim Irvine & Julian Chang*

Tricia Seow is Senior Lecturer, Kim Irvine is Associate Professor and Julian Chang is Teaching Fellow with the Humanities and Social Studies Education at the National Institute of Education.

Teachers draw on different knowledge bases and transform these in their pedagogy to create learning experiences for students to construct their own understandings. Geographical inquiry is a type of pedagogy premised on the constructivist view of knowledge and prioritises the need for students to make sense of things for themselves (Roberts, 2003; 2013). In Singapore, the Geography curriculum at the Secondary and Junior College levels privilege the inquiry approach as a “signature pedagogy” (Shulman, 2005) to construct geographical knowledge in the classroom and in the field. “Signature pedagogy” reflects an emphasis on disciplinary literacies and the need to help teachers and students understand the nature of disciplinary work (e.g., reading, writing, talking and working in the discipline). Shulman (2005) suggests that it consists of three dimensions: the concrete, operational practices employed by teachers; the deep structural understandings they have about knowledge in their subjects; and



the professional dispositions, beliefs and attitudes they have about their craft.

The Sustainability Living Lab (SLL) is a collective intervention by geography educators in partnership with geography teachers (Figure 1). It integrates real-world fieldwork sites (Jurong Eco-Garden, NIE Raingarden) equipped with environmental sensors and a virtual data portal with curriculum resources related to these fieldwork sites. The SLL affords unique opportunities for students to collect first-hand data of physical and human environments, make sense of a range of multimodal data and “have a go” at creating research questions or testing their hypotheses. The intention is to enhance teachers’ understanding and use of geographical inquiry as a “signature pedagogy” in order to induct

novice practitioners (i.e., students) into the disciplinary ways of constructing, representing and reconstructing knowledge.

The development of the SLL was guided by a qualitative exploratory study of six teachers in four secondary schools to investigate teachers’ knowledge of field-based inquiry into water quality, as well as the relationships with their concrete practices. The findings suggested that teachers had varying professional dispositions, beliefs and attitudes about the purpose of geographical inquiry. These included different emphases on scientific methodologies, geographical concepts, applied learning and environmental values. All the teachers expressed an appreciation for the role of inquiry in the construction of knowledge in geography. However, a key finding was the general misalignment among the concrete operational processes employed by teachers and their deep structural understandings and professional dispositions and beliefs. For instance, the field-based inquiries observed were highly teacher-directed (e.g., selection of hypotheses/inquiry questions, selection of sampling sites) with time and manpower constraints cited as primary factors. Finally, it was clear that teachers needed support with their content understanding of scientific concepts related to water quality indicators, and knowledge of the fieldwork site as a water catchment area.



Figure 1. The Sustainability Living Lab. The online component of the Sustainability Learning Lab can be accessed at <http://sll.hsse.nie.edu.sg/>.

► In response to these findings, the first phase of the SLL was designed to help teachers address the issues faced in operationalising geographical inquiry. These include:

- » High quality time series data within which teachers can contextualise the point data collected by students during the one time they visit the site.
- » Videos on fieldwork methods and site characteristics so that students can more independently prepare for the field-based inquiry.
- » Lesson packages and videos on inquiry in action based on the fieldwork sites in the SLL to support teachers in conducting the inquiry.
- » A detailed teachers' handbook addressing the scientific content and application of water quality indicators to better prepare teachers to facilitate inquiry-based learning with their students.

At different points in its development, focus group discussions were held with partner school teachers to collect their feedback on the SLL features and whether it met teachers' needs. For instance, teachers requested that both the data and graphs on the SLL be downloadable in various data and image formats due to concerns about classroom internet connectivity.

To date, at least seven schools and 950 students have used the fieldwork sites and resources provided in the SLL. The online teachers' handbook has also had 1,663 reads.

The next phase of the SLL development will involve the following:

- » A water quality mobile application with geo-tagged, spatial mapping capabilities to support field-based inquiry and crowdsourced data collection. The prototype of the app will be demonstrated to partner school teachers for feedback by early to mid-2018.
- » Partnership with the Learning Sciences and Technologies faculty at NIE to test alternative, more cost-effective water sampling equipment that can provide time series data across an expanded range of sites.
- » Collaboration with the English Language Institute of Singapore (ELIS) to support geographical literacy around multimodal data, with accompanying videos and curriculum materials.
- » Procuring funding for the development of curricular modules on *Weather and Climate*, *Coastal Systems*, *Tourism*, and *Urban Liveability* topics.
- » Integration of IoT sensors, including air quality and noise sensors to assess the benefits of green space.

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