The CREATE Lab
Overview and Motivation

Universities need to be integral members of their local communities, yet the university-community relationship is often freighted with complexity and inadequacy. The most locally effective university research projects justify sustained engagement with communities by studying the science of community learning and school reform directly, often from the university's education research departments. But universities conduct research across a broad spectrum of inquiry, and much of the science and technology innovation on campus focuses on uncovering and contributing fundamentally new disciplinary knowledge. This narrow and sharp focus can lead technology research projects into an uncomfortably asymmetric engagement strategy where communities serve as crucibles for experimentation and evaluation. Researchers arrive in a neighborhood, conduct tests and leave with enough experience and evidence to document the results in academic publications. Such projects can have tangible impacts in locales with real need. But rarely does this episodic university-community interaction lead to sustained change in society, because the new technologies and the practices surrounding them are fragile. They are just mature enough for a small pilot, rather than being iteratively refined for long-term robustness, scaling and sustainability.

We ask the question: how might a university innovation lab have lasting, meaningful impact in communities around the world? The derivation of knowledge is not enough for such strategic change. Real impact demands the coupling of deep problem understanding, innovation and cultural transformation. The Community Robotics, Education and Technology Empowerment Lab (CREATE Lab) at Carnegie Mellon is our ongoing experiment in a new model for university-community relations. We call this new model a *Community Lab* because we privilege sustained relationships above and beyond the technology innovation and knowledge-building processes, balancing technology invention with cultural transformation, and technical literacy with issue-driven advocacy.

To have profound impact, a Community Lab must engage with communities of practice at every stage of ideation, innovation, deployment, evaluation and scaling. We define need using participatory practices, then design and fabricate prototypes with custom electronics, hardware and software. Resulting pilot installations require training, and so the CREATE Lab designs curricula, runs teacher and community workshops and installs new technology shoulder-to-shoulder with local stakeholders. Early pilots lead to studies of scaling and sustainability, followed by engagement with

commercial partners for large-scale production and dissemination. And we do not stop there: after commercialization, we continue to support communities with regular training workshops, teacher residencies, technology lending libraries, grant writing support and technical support. This set of activities is diverse, and so the members of CREATE hail from mechanical engineering, psychology, graphic design, artificial intelligence, education, electrical engineering, computer science, interaction design and communications. Our community partners and stakeholders are equally diverse, surfacing for us issues as global as climate change and as local as middle school graduation anxieties. Our partners, with whom we establish lasting relationships, include internationally renowned scientists and artists; school districts; watershed associations; foundations; teachers; museums; partner universities; early childhood care facilities; conservancies; local mechanics; commercial manufacturers; federal agencies and many others.

With all the above partners, our goal is local empowerment: leveraging innovative technologies to support powerful forms of **inquiry**, **evidence-gathering** and **communication**. **Inquiry** prepares communities for change-making by sharpening their focus, engaging in a strengthened process of observation, examination and invention. For example, the *Arts & Bots* program aims to broaden diversity and participation in technology by re-integrating creativity with technical fluency. The project uses art materials, our custom *Hummingbird* processor, an interactive software environment, and curricula designed by schoolteachers through a residency program at CREATE to provide craft-based practices for creating provocative tangible sculptures with robotic actuation and sensing. The *Children's Innovation Project* exposes kindergarten classrooms to the process of active observation and documentation, the experimental nature of electricity and circuits, and finally repurposing the innards of ordinary electronic toys to create new demonstrations of interaction and electricity.

Evidence-gathering promotes the citizen to citizen scientist: fluent in capturing, hypothesizing about, and visualizing information that has real consequence to the community. *Waterbot* enables every student to adopt a local waterway, measuring water quality with unprecedented spatial and temporal density to co-generate comprehensive time-space maps of water quality throughout local watersheds. *Airbot* turns each user into a mobile air quality monitor, openly collecting distributed readings to produce new imagery of pollution in urban micro-climates, then inferring how micro-climates in the city lead to inequity in health justice. *GigaPan* transforms visual photographic surveys into exhaustive instruments for assessing ecological health, urban transformations, cultural detail and scientific and artistic missions. *BodyTrack* makes every user a data collector able to consider the health

consequences of all of his actions, from sleep patterns and exercise to nutrition, air pollution and light pollution.

Communication in its most potent form is effective advocacy: the ability to turn the art of inquiry and the evidence gathered into measurable change. As a Community Lab, CREATE invents new communication and visualization tools together with partners, then deploys these tools broadly to empower and engage. *Hear Me* provides a forum across school districts for capturing and broadly disseminating the most heartfelt and urgent calls for change that students feel. *GigaPan Time Machine* visualizes massive data with such high fidelity that the local consequences of global climate change become intimately apparent. *Message from Me* sends a five year old's voice home to her parents daily, boosting her ability to engage the parents in the intimate details of the school day such that their home interactions can become more consistent with school activities.

Inquiry, evidence-gathering and communication are just three examples of diverse forms of empowerment that every technology can afford, when its design is well aligned to the authentic needs of real communities of practice. In practice, no enduring technology stays fixed—it must adapt to real user needs constantly, and this unending evolution demands an intimate relationship between inventor and user.

The CREATE Lab is both a technology breeding ground and a community partner. It is this unique combination that enables a new form of local change: one that empowers the citizens to chart their technology future and, most important of all, their community's prospects for quality of life.