Ubiquitous Everything and Then Some

The media is buzzing about the “Internet of Everything.” The term ubiquitous computing became old-school before it even became reality, replaced by the Internet of Everything (IoE), aka the Internet of Things (IoT). This new conceptual framework—which essentially refers to the interconnectivity of devices, data, and people to one another and to the Internet—offers a rapidly evolving foundation on which to conjecture about the impact this connected technology will have on the future of society, learning, and education.

A year and a half ago, I moved from my role as Associate CIO for Academic Engagement at UC Berkeley to take on the role of CIO, VP-Technology, at the California College of the Arts (CCA), a mid-sized art and design college in the San Francisco Bay Area. CCA sits at the hub of the “maker culture” revolution. At an art and design school, “making” is king, and problem- and project-based learning is the norm. CCA, founded during the heart of the Arts and Crafts movement in the early 20th century, also takes seriously its mission to “make art that matters” and to be human-centered in its “making.” It is thus from this perspective that I take on the question of IoE’s impact on education.

Since 2008, the number of physical items connected to the Internet has exceeded the number of people on earth.1 Sensors are embedded in the phones in our pockets and also in common consumer devices such as refrigerators and cars; in addition, stand-alone sensors can be placed throughout our environment and set to communicate to our phones, clothes, watches, or jewelry. Campuses are now dealing not only with bring your own device (BYOD) but also with bring your own sensor (BYOS).

At the same time that buzz about IoE has exploded (both in investment2 and in talk), discussion about DIY (do-it-yourself) and maker culture and the “creative class” is being heard in the media and at higher education technology conferences. High schools and colleges/universities are moving to create “maker spaces” for their students in order to augment their now outdated computer labs. Maker spaces such as TechShop (http://techshop.ws/) and the Crucible (http://thecrucible.org/) offer classes and access to digital-fabrication tools to create lifelong learning nondegree hacker spaces for young people and adults. This explosion is aided by the emergence of open-source hardware, such as Arduino (http://www.arduino.cc/) or Raspberry Pi (http://www.raspberrypi.org/), and the consumerization of digital-fabrication tools such as 3-D printers. This strong presence of an open community is critical for education. Industry, left to its own devices, will likely focus first on the retail and consumer opportunities, taking more (often in the form of personal data) than it gives back. Open source and open hardware provide creative capability and offer a platform for the self-critical voice and dialogue necessary to support innovation and iteration beyond profit. The need for open standards extends to the integration layers, where cloud solutions such as Mulesoft (http://www.mulesoft.com) and Etherios (http://etherios.com) are beginning to appear. The higher ed enterprise staffing roles will increasingly become that of “UI tailors,” stitching together and applying context to the user experience.

As I began to explore the impact these trends could have on education, I called on a couple of colleagues who are more deeply involved in the design and making aspects of the growing IoE industry. Our conversations quickly revealed that IoE is still in its infancy and that our imagination regarding its impact is limited by the current model of education. Understanding the potential impact at more than a surface level requires a vision of a transformation of educational design and delivery—a transformation that has yet to come to fruition in mainstream higher education. Technology and technologists can help drive the vision of what is possible by assisting with a rapid evolution of online platforms and IoE technology. However, technologists should engage with learning experts and should challenge themselves to support and design high-quality solutions (ones that extend beyond technology) in order to improve and expand the range of learning experiences. By marrying the physical with the virtual, IoE has the opportunity to do just that. Add to that equation a problem-and project- based pedagogy that accompanies a maker and DIY culture, and we may have a greatly transformed learning experience that will change not only the format for the delivery of teaching and learning but also the content of the curriculum.

Enriching and Democratizing Educational Experiences
One of the IoE components that will open opportunities for education is in what I call, for lack of a better word, hypervisualizing: the ability to amplify access to knowledge of a device user’s current location. This is where a mobile device and/or sensor can correlate with personal and diverse information to aug-

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ment and deepen one’s understanding of the surrounding physical world. The learner can both consume and create. This type of experience is starting to appear in museums: iBeacons associated with an object can transfer stories in the form of text, video, audio, or multimedia.

Similarly, this technology can be used in many public spaces to augment learning; imagine how it could bring to life the rich and multilayered history of the twisting alleyways of the Barrio in Barcelona. Hypersituating may open interdisciplinary doors, allowing specific lenses—architectural, political, biological—to be focused on a single place. The experience of these locations can be kept alive through crowdsourced community contributions and augmented with students’ reflections and personal associations. Shared dialogue can be layered as another artifact and component, preserved so that future learners can hear the sounds and see the pictures and observations of those in the past. Michael Shiloh, a faculty member at CCA and an Arduino Educator, noted that experiments are being done to share scent remotely. Tokyo’s Kajimoto Laboratory is developing a machine to make it possible to kiss someone over the Internet. These types of innovations, though not inherently educational, show the early realization of the potential for bringing the kinesthetic experience of place to remote learners or visitors.

With open-source hardware, sensors or SDKs (software development kits) such as Supermechanical’s Twine (http://supermechanical.com/twine/), and fabrication labs replacing classrooms, the curriculum may shift as well. Students and educators can design and program the technology to capture and analyze data, as well as to extend and create their own interactive experiences. This puts the student in the seat of the researcher, the storyteller, or the teacher. Perhaps most important, the student is in control of the machine, learning to program and direct its attentions. This moves the student from being a passive consumer of mediated content to becoming a master of technology for purposeful inquiry. This type of hands-on engagement transforms learning from rote work to meaningful play.

Of course, IoE can alleviate mundane administrative tasks as well, such as attendance taking. Imagine automatically logging attendance: a student sits down in a lecture hall seat with its own small sensor, which communicates with the student’s phone to verify that the student did indeed attend class that day.

Managing IoE in the Institutional Milieu

IoE also introduces very real concerns about privacy of data and privacy of person. Technologists in educational institutions have a duty to educate and protect faculty, staff, and students. IoE continues what social networking began: breaking down the boundaries between the private self and the public self. As with any technology of such powerful potential, technologists must be very careful to manage it for good and to educate and inform faculty, staff, and students about the ethical considerations that accompany its adoption. There will be many places and times that educators and technologists will need to be proactive in carrying out the necessary dialogues and debates in order to protect privacy, diversity, and learning. As Marcel Bullinga, the futurist and the author of Welcome to the Future Cloud: The World in 2025 in 100 Predictions, has commented: “A major global megatrend here is de-skilling—our children will learn less and achieve more.” He goes on to say that this has clear advantages in terms of assisting better decision making in the moment but that it will also result in an increase in “major social distress” because of the multitude of video-capture devices such as Google Glass.

Opportunities for identify theft present new security concerns as data is increasingly moved across unmanaged, device-specific networks like low-energy Bluetooth (with more being developed every day). Social networking apps have already made it easy to inadvertently overlap personal boundaries, and institutions are struggling to create and manage meaningful new policies and honor codes around appropriate access to people and information—simple rules for managing the unwanted digital handshake.

These concerns add a new dimension to digital literacy and to the role of higher education in shaping, inculcating, and teaching—through constructive dialogue—a cultural norm that respects and values privacy as much as sharing.

Despite the challenges, I remain enthusiastic about the potential of IoE to positively influence the educational experience. Those of us in higher education technology should wade into the gray areas and help our learning communities understand and engage intellectually and ethically with these issues, as well as work directly with industry and the maker movement to harness the potential of IoE to shape and enrich deeper learning experiences into the future.

Notes

4. The iBeacon is Apple’s version of the low-energy Bluetooth protocol, which is increasingly embedded in mobile devices and for which a rash of new apps and sensors are being developed.
5. “Send a Kiss over the Internet with the Kiss Transmission Device,” https://www.youtube.com/watch?v=PspagsTFvlg&feature=player_embedded.

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