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Marco Figueiredo

Paola Prado
*Roger Williams University*, pprado@rwu.edu

Mark Cramer

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**Marco Figueiredo,** *Loyola University Maryland*
**Paola Prado,** *Roger Williams University*
**Mark Kramer,** *University of Salzburg*

A growing body of research is showing how digital inclusion can help communities overcome poverty and injustice—from Robert Jensen's 2007 study of mobile communication's economic impact on fishermen in Kerala, India,[1] to accounts of isolated rural villagers in Brazil earning college degrees online.[2] Indeed, one of the United Nations Millennium Development Goals (MDGs) aims to "make available the benefits of new technologies, especially information and communications," and the UN plans to use the number of mobile cellular subscriptions and Internet users as measurable indicators.[3]

Recognizing the potential of Internet access as a prime enabler, developed nations are heavily investing in greater bandwidth capacity and extending domestic Internet access to the "first mile." At the same time, developing countries that subscribe to the MDGs are actively searching for cost-effective models of diffusing information and communication technologies (ICTs) to help eradicate poverty and promote social justice. In particular, the emerging BRIC countries (Brazil, Russia, India, and China) have identified universal access to ICTs as an important indicator of developed nation status. Digital inclusion has become a top priority for these governments.

The main challenge lies in how best to achieve this goal. We argue that it must occur in two distinct stages. The first stage is *digital literacy*, which we'll accomplish with what we refer to as the symbiotic computer (SC)—smartphones and tablets. The second stage will be *professional capacity-building*, accomplished with the more traditional personal computer (PC).

## PC Barriers to Digital Inclusion

Although the digital inclusion movement has gained momentum in the past decade, efforts to promote widespread ICT adoption continue to face substantial challenges. For a long time, the PC has been the gateway to the digital world, but the PC isn't actually all that personal. It's more of a business automation tool, hardly suited to engage those who are digitally illiterate.[4] The use of the mouse is a real challenge for the elderly, and the keyboard is a dreadfully complex tool for the functionally illiterate. The PC user interface is also highly sophisticated, leading to a longer learning curve and higher upfront investment to derive worthwhile benefits.

Indeed, research shows that efforts to promote digital literacy and professional capacity-building can fail among populations where educational attainment is low, interest is low, and where there is little or no supportive social networks or relevant content to reinforce learning.[5] Beyond the simple challenge of basic Internet availability, the bandwidth capacity is also a limiting factor when it can't support multimedia content (images and videos) and effective peer-to-peer video communications—an essential requirement in less literate communities that prefer face-to-face communication. A better overall solution is required to facilitate the digital inclusion process through more effective and affordable technologies that meet the needs of most people on a global scale.

Toward addressing this goal, a breakthrough first appeared in the mobile phone market. It was Apple


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that once again integrated a set of new technologies and brought affordable touch-screen devices and computers to the marketplace. By eliminating the mouse, hiding the keyboard, enabling easy access to video communications, and including a suite of sensors and actuators to improve the user experience, Apple brought us to the age of the real personal computer, which we call the symbiotic computer (SC) because of its symbiosis with humans.[6] Some view SCs as wearable devices, but others go a step further by arguing that they're emotionally embedded in us[7] and augment our capabilities. The day might soon come when these tools are physically embedded in us as well.

## SC Applications for Digital Literacy

Some say that the electronic spreadsheet was the killer application for PCs, which makes sense if you see PCs for what they are: business automation tools. The killer application in the SC world was the telephone. It's most successful iteration is the iPhone.

Unlike the electronic spreadsheet, which was an innovation in itself, the telephone, which long preceded the advent of the SC, has become one more among hundreds of thousands of personal applications. The SC will be essential if four billion people who are digitally excluded are to join the digital age. It's the ultimate digital literacy tool.

### Robotic Avatars

When the smartphone SC screen is too small, there's the tablet or television SC. The SC involves every aspect of our personal lives, not just professional aspects, and its capabilities are only expected to grow. A larger suite of sensors and actuators will eventually turn SCs into our robotic avatars, allowing us to multiply our presence to several locations simultaneously and to explore environments not suitable for humans.

For example, attaching an SC smartphone to a low-cost robotic submarine or helicopter allows the average user to explore underwater and aerial scenarios for knowledge gathering or pure entertainment. We can envision a multiplier effect in a telepresence scenario where a single presenter interacts with multiple audiences around the world through robotic avatars. Although the latter scenario is possible today without the SC, its ubiquitous presence around the world will facilitate the multiplier effect for the average user.

### Augmented Reality

Another SC application area exists in augmented reality, where a view of the real-world environment is augmented to provide extra information that improves interpretation. For example, the SC camera image can be augmented with historical information retrieved from a global knowledge base by providing the user's GPS location. The user can use his or her fingers to enter information on the SC touchpad, and multiple users can interact in real time through audio communication while sharing the same view to facilitate *collective exploration*.

### Education

Education will greatly benefit as we move all textbooks to the tablet SC, reduce paper usage, and greatly improve access to knowledge. New books can be easily introduced and interactions between teachers and students made more adaptive.

The One-Laptop-Per-Child (http://one.laptop.org) program recently introduced a tablet version. It leverages the SC concept to further the OLPC peer-to-peer learning model with applications that let students and teachers collaborate in real time—whether in the classroom or virtually. The SC effectively breaks the walls of traditional educational institutions and makes learning an on-going and adaptive community experience. Once strengthened by universal broadband Internet access, online learning aided by SCs will become more cost effective, allowing larger segments of the population to use the cognitive surplus to collaboratively process and create new meaning.[8] Clay Shirky, Amit Goswami, and others foresee this as a path to building more just societies.[9]

### Mobile Health

Another promising application area is mobile health (m-health). Individuals can harness mobile devices to capture, track, and share relevant health information through mobile telecommunication and multimedia technologies. Furthermore, m-health can augment and support healthcare delivery and broaden access to healthcare for individuals and communities. The UN Foundation and Vodafone Foundation report presents six application categories within the m-health field: education and awareness, help-lines, diagnostic and treatment support, communication and training for healthcare workers, disease and epidemic outbreak tracking, and remote monitoring and data collection.[10]

### Online Banking

Already under way is the application of SCs in payment processing to expand access to online banking. A smartphone SC can be used to scan a debit or credit card on the spot or simply allow for fund transfers between users through near-field communications, eliminating the need to carry cash or cards. Micropayments are a natural development once banking becomes completely integrated in the cyberspace ecosystem. In a universally connected society, money no longer needs to

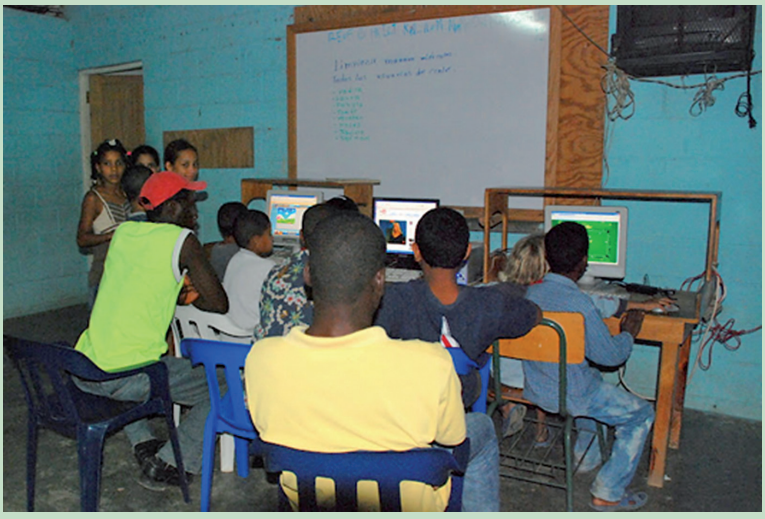

**Figure 1. Shared access in El Limon de Ocoa, Dominican Republic. Rural residents rely on this public access, community-financed telecenter. (Source: Pradomedia; used with permission)**

be expressed as a physical entity and can be sub-divided in even smaller fractions, allowing further monetization of knowledge. In this scenario, the SC becomes the wallet.

## Facilitating SC Adoption

Paving the way to universal cyberspace access, SC adoption is quickly spreading via the cellular communications business model. Telecommunications companies finance smartphone SC devices by subsidizing a large portion of the initial cost and recovering the total value in the monthly communication fees over a long-term usage contract. This model has served high-end users well, but the monthly costs for a sufficient broadband allowance are still too high for most people.

Google has further facilitated adoption with its open-source model, quickly grabbing market share with the Android platform while delivering free- to low-cost applications in a server-based technology management solution. However, there are still challenges.

### Pricing Concerns

The best and most useful SCs are still unaffordable for the poor, deepening the digital divide and compounding the roster of ineffective solutions available on the market.[11] To significantly increase digital literacy, we must offer adequate computing power at the right price point.

A smartphone or tablet SC with dual-core gigahertz-processor technology currently costs, on average, $600 in the US—an order of magnitude higher than what most people can afford on a global scale. Given abundant Wi-Fi-like broadband availability, these devices already offer an optimum entry point for satisfactory delivery of most applications. Once this technological solution can be produced and commercialized at around $60, and broadband access is affordable for everyone, we will have reached the breaking point in the digital inclusion curve.

### Broadband Expansion

Ultimately, the future belongs to communities that can roll out affordable gigabit-broadband through fiber optics connected to the home. Gigabit-per-second broadband connections enable high-fidelity peer-to-peer video communications. South Korea is one country on the path to deploying just such an environment.

In the meantime, incremental development is occurring with the roll-out of wireless communications, such as satellite, cellular, and Wi-Fi based networks, and wired networks, such as cable and DSL. One approach that has been successfully explored worldwide to reach underserved communities is the shared-access model through community telecenters, including government, nonprofit, and for-profit ventures (see Figure 1 and the short video at www.gemsoftheearth.org/ruraltelecentervideo).

## A Bridge to Professional Capacity-Building

While the widespread adoption of SCs enables digital literacy, the second stage of professional capacity-building through the use of PCs is best implemented by the shared-access model and its peer-to-peer learning. Telecenters as public access places to ICTs are still the most economical and effective model to promote universal access. They remain a relatively affordable gateway for ICT diffusion and capacity-building (job training and knowledge-sharing) in low-income communities.

However, the shared-access model must be adjusted to serve as a bridge between the SC and PC. The demand for simplified PC user interfaces in a telecenter isn't as high as before since users will already be familiar with SCs and more willing to learn an automated office environment to help in getting a job or running a business in the digital age.

### Cloud Computing

The proven concept of software delivered under central-server

control to low-cost and low-maintenance PCs must be adopted by telecenter networks. A cloud-based approach, in which the operating system running in the telecenter computer gets its configuration from a central server somewhere on the Internet (as in the SC world), is the right solution.

The user can request the installation of a new application, but configuration control stays at the central server, which can also push an operating system update. The user can keep his or her data in the cloud or in an SC. The light PC architecture shouldn't use moving parts (such as rotating hard disks, which can lead to more frequent defects), and unit replacement should be affordable when defective (because it's easier to replace the entire unit).

### Free and Open Source Software

The use of Free and Open Source Software (FOSS) is a key to this model's success. Proprietary software is usually too expensive to serve the poor. Its price would have to come down by an order of magnitude to be affordable. Anything above $10 is too costly; the price point should be approximately $1, which is easily justified by the increase in market size through widespread digital inclusion.

Besides, the proprietary software model of the PC world requires continuous paid upgrades or exclusion. It only works when there is a direct financial benefit derived from its use, as in the case of holding a job where experience with the software is required. Proprietary software that's affordable or available for free with advertisements should work as well as it does in the SC world.

### Wi-Fi Hubs

Telecenters ought to be Wi-Fi hubs that connect SCs to the Internet backbone and provide a community with a media server to facilitate local content creation, dissemination, and affordable local voice and video communication. Telecenters could also provide cached Internet content (as with Wikipedia) to reduce bandwidth requirements and lower Internet connection costs, and could continue to provide access to more expensive resources, such as printers, scanners, copiers, video projectors, and media production tools.

The Android world has yet to develop a point-of-purchase model that vies with the popularity of an Apple Store. Telecenter networks might do well to look to this model for guidance in how to attain financial sustainability.

Together, the SC and shared-access model facilitate digital inclusion. The telecenter peer-to-peer learning-model enhances a community's ability to forge a socially just and progressive path toward environmentally sustainable development and better standards of living for all. As a personal tool, the SC marks a revolutionary step in the use of ICTs to alleviate poverty. It also changes the assumption that only the wealthy can pay for new technology.

The sheer size of the SC market will demand innovation directed toward the needs of the poor. The quicker a product reaches this market, the more successful its producers. Furthermore, in this early stage of the Internet, there are plenty of opportunities for newcomers to leverage their local emerging markets and to develop global solutions instead of waiting for the innovations to trickle down from more developed markets.

### References


1. R. Jensen, "The Digital Provide: Information (Technology) Market Performance, and Welfare in the South Indian Fisheries Sector," *The Quarterly J. Economics*, vol. CXXII, no. 3, 2007, pp. 879–924.
2. P. Prado, M.A. Camara, and M.A. Figueiredo, "Evaluating ICT Adoption in Rural Brazil: A Quantitative Analysis of Telecenters as Agents of Social Change," *J. Community Informatics*, vol. 7, nos. 1–2, 2011; http://ci-journal.net/index.php/ciej/article/view/663.
3. *Millennium Development Goals Indicators*, United Nations, 2012; http://mdgs.un.org/unsd/mdg/Default.aspx.
4. S. Groisman, "Gems of the Earth," Globo television documentary, 6 June 2009; www.gemsoftheearth.org/node/12.
5. P Prado, "Bridging Digital Poverty: Adoption of Information and Communication Technologies at Community Technology Centers in the Dominican Republic," doctoral dissertation, School of Communication, University of Miami, 2009.
6. J. Rosnay, *The Symbiotic Man: A New Understanding of the Organization of Life and a Vision of the Future*, Mcgraw-Hill, 2000.
7. S. Turkle, *Alone Together: Why We Expect More from Technology and Less from Each Other*, Basic Books, 2011.
8. C. Shirky, *Cognitive Surplus: Creativity and Generosity in a Connected Age*, Penguin Press, 2010.
9. A. Goswami, *How Quantum Activism Can Save Civilization: A Few People Can Change Human Evolution*, Hampton Roads Publishing, 2011.
10. "mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World," Vital Wave Consulting for the United Nations Foundation and Vodafone Foundation, Feb. 2009, p. 9; www.globalproblems-globalsolutions-files.org/unf_website/assets/publications/technology/mhealth/mHealth_for_Development_full.pdf.
11. J. Bhattacharya, C. Devi, and K. Foster, "Searching for the Aakash—Yet Another Ultra-Inexpensive Computer Project Falls Short of the Mark," *IEEE Spectrum*, Apr. 2012;

http://spectrum.ieee.org/geek-life/tools-toys/searching-for-the-aakash.

***Marco Figueiredo*** *is director of the Center for Community Informatics at Loyola University Maryland. His research interests include digital inclusion, robotics, and high-performance computing. Contact him at mafigueiredo@loyola.edu.*

***Paola Prado*** *is an assistant professor of communication at Roger Williams University in Bristol, Rhode Island. Her research focuses on the adoption of information and communication technologies for development and social change in Latin America. She is the co-creator of the* Community Communicators *journalism and multimedia workshop program. Contact her at pprado@rwu.edu.*

***Mark Kramer*** *is a doctoral candidate at the University of Salzburg's ICT&S Center/Communication Science Department. His research interests include social informatics, mobile society, and digital inclusion. Contact him at mark.kramer@sbg.ac.at.*