

# Informal Health and Legal Rights Education in Rural, Agricultural Communities Using Mobile Devices

Jaspal S. Sandhu, Jonathan Hey, Catherine Newman, Alice M. Agogino  
*University of California, Berkeley*  
*{jaspal, jono, kay, agogino}@berkeley.edu*

## Abstract

*The focus of this work is on the design of a system for informal education in rural, farmworker populations using mobile devices. We have conducted needs assessment with farmworkers in the California Central Valley in conjunction with engineering and industrial design students as part of a service learning initiative. The community, working with the students, identified key needs related to accessing information, emphasizing health and legal rights. We propose the possibility of wireless access to digital libraries for access to this information. We discuss an appropriate system design using mobile phones and future plans for user testing with the community. We stress the importance of continually working with the community to develop relevant and sustainable solutions.*

## 1. Introduction

As in many countries across the developing world, agricultural workers in the United States represent a rural, underserved segment of the population. Estimates indicate that migrant and seasonal farmworkers alone total over 4 million, or more than 1% of the U.S. population [15]. Understanding the demographics of this population is key to developing educational solutions. Despite common perceptions, the composition and behavior of this population is highly complex. To begin with, there are three classifications of farmworkers: follow-the-crop migrants; shuttle migrants, who move between two or more jobs within a region; and non-migrants [23].<sup>1</sup> In total, 56% of farmworkers travel for employment; 42% overall maintain homes in their native countries, where they return in the off-season. Among those who “follow the crop”, there are three distinct streams

<sup>1</sup> All information contained in this section – unless explicitly referenced otherwise – is from the National Agricultural Workers Survey (NAWS) [23], the most reputable and comprehensive source of demographic data on U.S. agricultural workers.

that workers follow each year: the Eastern stream, beginning in Florida and going up to New England and Ohio; the Midwestern stream, originating in southern Texas and diverging to most states in the Midwest; and the Western stream, beginning in southern California and moving north along the coast [5].

Approximately 80% of farm workers are foreign-born and the overwhelming majority of these (95%) were born in Mexico. Still, many other populations participate in agricultural work, including Native Americans, Jamaicans, Laotians, Filipinos, Haitians, Puerto Ricans, and Hmongs [8]. Spanish is the native tongue for 84% of this population, English represents 12% and Tagalog, Ilocano, Creole, and Mixtec comprising most of the rest.<sup>2</sup> Literacy is decidedly low as 85% of farmworkers are unable to decode printed information in either their native or adopted language. Tremendous income inequalities distinguish this group from the rest of the U.S. population; compared to the per capita GDP of more than US\$37,000, half of all farmworker *families* earn less than US\$10,000 annually.

Poor access to healthcare in the United States and substandard working conditions for many of these immigrant farm workers has resulted in health problems of greater severity and significance than in the general population. For example, life expectancy is only 49 years as opposed to the national average of 73 [21] and the HIV infection rate is estimated to be 10 times the national average [11]. The illegal immigration status of many of these workers plays an important role in that when in unsafe working conditions or when in need of services they are unlikely or unable to leverage or bargain for better care.

<sup>2</sup> Tagalog and Ilocano are spoken by Filipinos, and Mixtec is spoken by a Native American people from Oaxaca, Mexico. Creole is a highly complex term for describing language, but in this context refers to a language spoken by many people from the Caribbean.

The focus of this work is on the development of a system of disseminating health and legal rights information to rural, agricultural populations via mobile devices. Our research involves primarily Spanish and English speaking farmworker communities in California (see Fig. 1).



**Figure 1.** Agricultural communities in the California Central Valley serve as the direct context for this research.

California's importance in agriculture cannot be understated, as it is by far the largest generator of agricultural revenue in the U.S., as well as its largest producer of fruits and vegetables. Of the 4 million MSFW (migrant and seasonal farmworkers) in the United States, 1.3 million work in California [15].

This population of agricultural workers in the United States has many similarities with workers in developing countries. This work has direct relevance to similar initiatives with agricultural communities in Canada and Mexico, since they operate under many of the same conditions [26]. More broadly, results from this research may be used to inform education of migrant populations across the world.

## 2. Related work

The foundation of this research is the continual involvement of the community in the design of the information system. We assert that this is necessary, but by no means sufficient, for generating a culturally relevant and sustainable solution. Within this framework, we will investigate the most appropriate means of disseminating information, whether it is in the form of information on-demand, "pushed" information, or bidirectional communication. Additionally, given issues of literacy and language, we are investigating how individuals can play an integral part in the dissemination of information in combination with the system.

This project draws on prior work in a variety of fields; the most relevant work is from the areas of: social dynamics of farmworker communities, sharing of ICT (information and communication technologies) resources, and community-based design methods. Educational methodologies and literacy studies are also highly relevant to this work.

Information dissemination of any sort in farmworker communities is challenging for many reasons including the largely transient nature of the population, rural setting, language diversity, and limited literacy. Language is not the only barrier to information access; in some cases critical information is withheld from workers [18]. This directly motivates the use of centralized digital libraries for free, universal access to key information. One hypothesis is that collective action [19,25] can be used to more effectively disseminate information. This is especially promising given the evidence in favor of personal networks as a medium for accessing information in these communities [10]. Examining social structure and its potential for sharing resources is a key portion of our upcoming work.

Sharing of ICT resources is a concept that has received prior attention from researchers. Grameen Phone, paying for usage on an entrepreneur's mobile phone, was based on the premise that economic sharing of a resource was appropriate for many developing contexts such as Bangladesh, where it began [14]. Further, many Internet kiosk models are based on the sharing of common resources, largely for economic reasons; among the more famous examples are the ITC (Indian Tobacco Company) e-choupals, which were designed primarily as a marketplace for rural farmers [3].

However, despite these and a number of other initiatives, a theoretical framework for sharing of ICT resources does not exist. Our proposed investigation of sharing has a social basis, as well as an economic one. Because of the social dynamics of the community and because of the limited literacy rates, an alternative to a device such as the Simputer [19] is to leverage the personal networks within the community – rather than arbitrarily flexible technology – for dissemination of information.

An integral part of our community-based design process involves user needs assessment, with human-centered design as an underlying paradigm [4,7,16]. However, in urban planning projects, capacity-focused development has been proposed as an alternative paradigm to needs-driven design, emphasizing the use of community resources in order to develop sustainable programs [12]. In fact, our work proposes to utilize both paradigms, to first identify community needs and then to leverage the communal assets in order to meet these needs. [9] is

particularly notable for its relevance to this work in terms of community-centered design, an information systems application, a Spanish-speaking community, and service learning (integrating learning with community service).

### 3. Preliminary needs assessment

Our initial needs assessment was a collaboration among industrial design students from California College of the Arts, and first-year undergraduate engineering students participating in a design module at UC Berkeley. The purpose of this collaboration was twofold: to develop more effective, sustainable solutions and to engage students in this process through service learning. Service learning has been shown to provide increased student motivation and a deeper understanding of course content [17]; and we believe it can lead to the development of more effective design solutions.

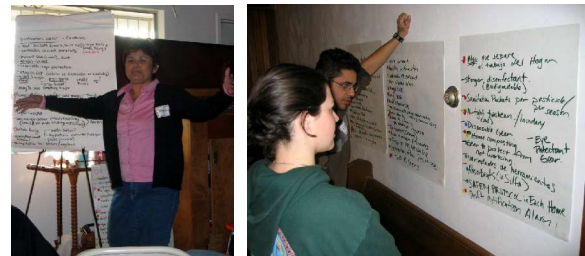
Field research, supplemented by significant secondary research, consisted of rapid ethnography methods and direct observation. Preliminary fieldwork was conducted in Napa County and the San Joaquin Valley. After establishing an initial understanding of farmworker communities in California, we visited the town of Earlimart (population 6,500).

On the night of November 13, 1999, a pesticide cloud descended over Earlimart. This pesticide drift induced many residents to begin vomiting. Later that evening, members of the community were instructed to go to the school and disrobe in public where they were then sprayed with cold water from a fire hose. The lack of preparation and respect for the affected residents of Earlimart by the emergency services has left a permanent memory of the incident.

At Earlimart we participated with the community in an "innovation workshop" comprising of needs assessment, brainstorming, and concept development sessions (see Fig. 2 and Fig. 3). The workshop was conducted in both English and Spanish, with translation performed by bilingual members of the community and students, including several native speakers.



**Figure 2.** The innovation workshop took place at an Earlimart church. These principles were used to create an open environment for discussion of needs.



**Figure 3.** A community leader (left) presents her group's design concepts to the larger audience. Students (right) discuss specific design ideas based on the concept generation.

Eleven Earlimart residents, all of whom worked in the fields, participated in this day-long innovation workshop. One woman was originally from Peru, the others were immigrants from various parts of Mexico, including Veracruz, Guadalupe, Zacatecas, and Michoacan. The workshop was begun with exercises to build trust among all parties and create a common understanding of the term technology (*la tecnología*). The key needs emerged during small group brainstorming sessions. The question asked of the Earlimart residents was: *How can technology better improve the health and safety of farmworkers, their families, and their communities?*

Of the needs that emerged from the community, many revolved around health and information. Concerns about pesticides and water contamination were very common, as was a need for better education and understanding of legal rights. This motivated the investigation of an ICT-based solution to educate farmworkers about health and legal rights. This is precisely in line with Wilk's recommendation to "develop culturally appropriate health education materials for farmworkers on workplace health and safety, preventive health care, including dental health,

deafness prevention, child growth and development, infant feeding practices, nutrition, family planning, sexually transmitted diseases, substance abuse, and use of medications” [24]. Further, investigation of an ICT-based solution is supported by Wilk’s assessment of the highly complex legal structure pertaining to farmworkers in the workplace [24].

#### 4. Selecting Appropriate Technology

Mobile devices accessing content from digital libraries provide a powerful solution to meeting the information needs of these communities. Digital libraries provide a flexible means for users to interact with information that can be updated regularly and served from a central location. Mobile phones in particular provide great flexibility in terms of movement and are both accepted and used within these communities. Access from remote or distant locations is especially important given the high seasonal mobility of these communities.

In addition to mobility, increased network coverage, and high technology penetration, we also examine mobile phones because of the lower unit cost when compared to ICT kiosks, as have been implemented in other similar initiatives. For example, [1] details a health-education kiosk from Mexico City that is now being adapted for California agricultural communities; this is an appropriate solution for the hospitals where they are deployed, but not in the communities themselves.

We are still investigating appropriate technology solutions; mobile phones are simply one of several possibilities for accessing relevant information. Additionally, it will be necessary to compare the selected technology to other means of information dissemination – including less technological alternatives such as the radio and non-technological ones such as printed pamphlets.

Within this framework, the choice of technology (or technologies) is informed by a combination of complex factors beyond the target application. These factors include: (1) the nature and culture of the target population (see [22]); (2) the nature of communication (e.g., information on-demand, pushed information, bidirectional communication; information dissemination through key community members); and (3) the appropriate combination of available media including voice/audio, text, images and video.

Current mobile devices can communicate using all of these media types and devices are getting both cheaper and more powerful each year. It is necessary to identify the strengths and limitations of each form of media, and to examine how each form can best

support another. The criteria for the selection of appropriate media must be drawn from more in-depth user-needs analyses within the context of the community. There may prove to be a diverse set of media-combinations [13] which best addresses the diverse information needs of the community [2]. Examples of mixed media include: (1) an image with caption, or iconic-annotations on the image; (2) an informative audio clip with follow-up information attached as text; and (3) a community-specific icon language that is translated into text or audio.

In conjunction with these user-interface level issues, macro-scale constraints will dictate the appropriate choice of technology. Mobile phones make best use of the existing infrastructure in these rural areas, and the prevalence of mobile handsets among the population<sup>3</sup> make them a technology that is both trusted and understood. Leading possibilities in other international settings include WLL (wireless local loop) devices. The diversity of languages and varying literacy levels make successful dissemination of information highly challenging. Rather than building translation capabilities and a speech interface into any device, we propose using the dynamic nature of the population for more effective information dissemination. Sharing a resource – in this case a mobile handset – makes greater economic sense, but also allows for information dissemination via existing personal networks. As we proceed with this work, we acknowledge that there exists a concern from members of the community that jealousy or friction may result from an uneven distribution of devices or other resources.

The economics of any proposed system are critical to its successful adoption and continued use. Any system-level research in the area of technology and education must have a viable, sustainable business model. A stronger claim is that there must be some market-driven need for the technology in order for it to have a chance at long-term viability. This is not a central focus of our work at this stage, but it is a consideration. This is the reason for leveraging existing mobile telephone networks and for examining a technology that has already found footing in the community.

#### 5. Assessment

From the collaborative identification of the community needs we will begin development of prototype interfaces for early phase testing. We will also inform our design through upcoming ethnography, during which we will observe mobile

---

<sup>3</sup> Based on anecdotal observations from contacts within the communities.

phone use by farmworkers at home and in the field, and examine the existing frameworks for community information dissemination. We will follow an iterative and interactive process for system and interface development incorporating the input and skill levels of target users.

The usability and HMI (human-machine interface) analysis will compare multiple modes of interaction and usage primarily using ethnographic techniques including direct observation and will be supplemented by surveys or structured oral interviews. In addition, user-studies will be performed including cognitive walkthroughs.

Once a robust interface is developed we will conduct small-scale deployment studies with a subset of the target user group. Feedback from smaller studies will inform the final development of the information service.

The testing will provide answers to several key research questions. What is the most appropriate hardware for this application? In the specific context of health and legal rights education, what is the most important information? How can humans and the sharing of mobile devices play a role in the dissemination of this information? What are the most appropriate media combinations for this community and individuals given the specific information needs? What other possibilities does the information dissemination framework provide?

We are implementing this educational project in a very specific context and are tailoring the solution based on the local environment. We recognize that results do not allow broad generalizations over arbitrary communities. However, the experience gained and processes used in implementing such a system successfully will no doubt be useful when developing systems for other similar contexts. Therefore to maximize the transferability of the results of our assessment we will use the design-based research methodology [6] to define alternative scenarios to which this learning paradigm can be applied.

### Acknowledgements

The authors would like to thank the following for their assistance and cooperation: Teresa DeAnda of Californians for Pesticide Reform; the Earlimart community that participated in the design process; Gloria Montano from the Anita Borg Institute of Women and Technology, for conducting the design workshop; Prof. Leslie Speer and her students from the California College of the Arts; and the Berkeley engineering students from the course E10. This work was funded in part by the following: Procter and Gamble, Ricoh Innovation, Hewlett-Packard Labs,

University of California (Discovery Grant) and NSF grant #10201.

## 6. References

- [1] A. Langer, T. Aldrich, and J. Catino, "Improving Prenatal Care in Mexico City: Impact of an Interactive Computer-Based Education and Empowerment Tool", presentation, *XVII FIGO World Congress of Obstetrics and Gynecology*, Santiago, Chile, November 2003.
- [2] A. Pavlenko "New approaches to concepts in bilingual memory", *Bilingualism: Language and Cognition*, 1999, pp. 209-230.
- [3] B. Bowonder, V. Gupta, and A. Singh, "Developing a Rural Market e-hub, the Case Study of e-Choupal experience of ITC", *Indian Planning Commission Report*, 2002.
- [4] Burkey, S., *People First: a Guide to Self-reliant Participatory Rural Development*, Zed Books, London, 1993.
- [5] *The Conexiones Project*, <http://conexiones.asu.edu>, Feb 2005.
- [6] Design-based Research Collective, "Design-based Research: An Emerging Paradigm for Educational Inquiry", *Educational Researcher*, Vol. 32(1), 2003, pp. 5-8.
- [7] Endsley, M.R., B. Bolté, and D.G. Jones, *Designing for Situation Awareness: an Approach to User-Centered Design*, Taylor and Francis, London, 2003.
- [8] Farmworker Health Services Inc. *About Migrant and Seasonal Farmworkers*, <http://www.farmworkerhealth.org>, Feb 2005.
- [9] J. Alm, M. Aronson, and R. Bailey, "Running Undergraduate Projects in Developing Communities: Implementing a Healthcare Information System in a Hispanic, Border Community", *ASME DETC (Design Engineering Technical Conferences)*, Salt Lake City, UT, 2004.
- [10] K.E. Fisher, E. Marcoux, L.S. Miller, A. Sanchez, and E.R. Cunningham, "Information Behavior of Migrant Hispanic Farm Workers and their Families in the Pacific Northwest", *Information Research*, Vol. 10(1), Oct 2004.
- [11] K. Fitzgerald, J. Chakaborty, T. Shay, S. Khuder, and J. Duggan, "HIV/AIDS Knowledge Among Female Farm Workers in the Midwest", *Journal of Immigrant Health*, Vol. 5, 2003, pp. 129-136.
- [12] Kretzmann, J.P., and J.L. McKnight, *Building Communities from the Inside Out: a Path Toward Finding and Mobilizing a Community's Assets*, Center for Urban Affairs and Policy Research, Evanston, IL, 1993.

- [13] M. Hegarty, and M.A. Just. "Constructing mental models of machines from text and diagrams", *Journal of Memory and Language*, Vol. 32, 1993, pp. 717-742.
- [14] M. Yunus. *Alleviating Poverty Through Technology*, *Science*, Vol. 282, 16 Oct 1998, pp. 409-410.
- [15] National Center for Farmworker Health. *About America's Farmworkers Fact Sheet*, 2004.
- [16] Noyes, J.M., and C. Baber, *User-Centered Design of Systems*, Springer, London, 1999.
- [17] R.G. Bringle, and J.A. Hatcher, "Implementing Service Learning in Higher Education", *Journal of Higher Education*, Vol. 67(2), 1996, pp.221-239.
- [18] R. Parrott, K. Wilson, B. Buttram, K. Jones, and C. Steiner, "Migrant Farm Workers' Access to Pesticide Protection and Information: Cultivando Buenos Habitos Campaign Development", *Journal of Health Communication*, Vol. 4(1), Jan-Mar 1999.
- [19] R. Rodriguez, "The Power of the Collective: Battered Migrant Farmworker Women Creating Safe Spaces", *Health Care Women International*, Vol. 20(4), Jul-Aug 1999, pp. 417-426.
- [20] *The Simputer Project*, <http://www.simputer.org>, Feb 2005.
- [21] Substance Abuse and Mental Health Services Administration, *Community and Migrant Health Center Course: Population Specific Concerns*, <http://p2001.health.org>, Feb 2005.
- [22] T. Makela, "Multimedia Software as Culture: Towards Critical Interaction Design", *IEEE Multimedia*, Vol. 12(1), Jan-Mar 2005, pp. 14-15.
- [23] United States Department of Labor, *Findings From The National Agricultural Workers Survey (NAWS) 1997-1998*, March 2000.
- [24] Wilk, V.A., *The Occupational Health of Migrant and Seasonal Farm Workers in the United States*, Farm Worker Justice Fund, Inc., Washington D.C., 1986.
- [25] Wilk, V.A., *Reducing Health Risks: Farmworker Women Working Together*, in McDuffie, H.H., et al., *Agricultural health and safety: workplace, environment, sustainability*, Lewis Publishers, Boca Raton, FL, 1995.
- [26] Wright, A., *The Death of Ramón Gonzalez: The Modern Agricultural Dilemma*, University of Texas Press, Austin, TX, 1990.