Reflections on Designing Communication Devices for Rwandan Schools

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ABSTRACT

Disability design and innovation in low resource settings comes with many challenges and opportunities for positive change. It is in fact this tension of opportunity and responsibility that we must examine. In this work I share the stories behind developing a communication device for three Rwandan schools. We designed and built Ijwi, a communication device for children that are starting out using communication devices and compared it to other available solutions to understand how we could best support non-speaking students in inclusive education programs. We worked with advisors from a global disability NGO to understand how we could best design the device for their inclusive education programs in Rwanda. I share the details of the communication device we build using off-the-shelf components and some reflections about the lessons we learned in the field.

INTRODUCTION

What do we mean by development in the information and communication technologies for development (ICT4D) community? How are we currently measuring growth and change with the digital solutions we are researching? How can we leverage our research knowledge and methods to truly understand how technology can support ongoing local efforts? These are just some open questions for the community I have been pondering after working with the Assistive Labs team as lead researcher and designer of a communication device.

In 2015, I co-founded Assistive Labs along with Alexandra Berrio, and Tomás Vega. Assistive Labs was born from the need to increase the access of assistive technologies in low- and middle-income countries through the development of open-source assistive technology [1]. Humanity for Inclusion (HI), a global NGO working locally in Rwanda approached our team seeking a solution to significantly improve student learning and participation in their inclusive education programs. We learned that at the time there were no augmentative and alternative communication (AAC) devices being used in their Rwandan programs to aid speech and language learners. Current products are exorbitantly expensive and limited access to basic requirements such as electricity render the devices available in the market inefficient and poorly designed and not appropriately designed for the Rwandan context, thus creating additional barriers to education.

Non-speaking individuals are highly discriminated against in terms of assistive device provisions around the world. Most international development projects focus on traditional assistive devices such as wheelchairs, crutches, mobility aids, hearing aids, and eyeglasses. Often, children and adults with needs for alternative communication solutions are overlooked or only provided with a basic communication board. The lack of communication devices in schools and homes can impact inclusive education efforts. Only 1% of children with disabilities attend school—a figure which drops as children progress from primary to secondary school [2].

Additionally, the World Health Organization launched a Priority Assistive Products List in 2013 and then again in 2018 making a call for the development of affordable and appropriately designed assistive products including augmentative and alternative communication (AAC) devices [3]. This call and the need for appropriate communication devices for the inclusive schools in Rwanda motivated the creation of Assistive Labs and the design of Ijwi, an open-source AAC device (figure 1).

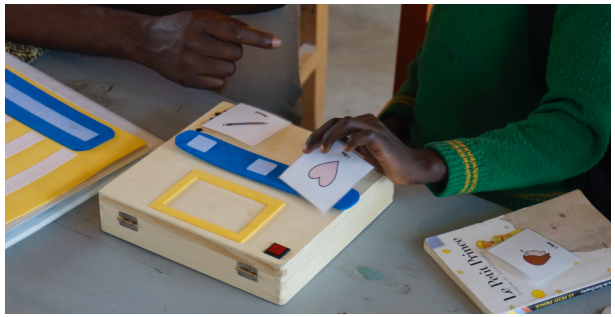

Figure 1. A student is placing a pictogram tagged with a RFID sticker on Ijwi, an open-source speech-generating device that reads reprogrammable RFID-tagged words and translates them into sounds.

IJWI – OUR DEVICE IN THE FIELD

Ijwi—meaning voice in Kinyarwanda, Rwanda's official language, is an AAC device that reads RFID information from multiple pictograms (cards with symbols) and translates this RFID input to a corresponding sound. Non-speaking children can use the device as a language learning tool and means of communication both in and outside of the classroom. The design contains a physical board with a hidden RFID sensor inside and multiple slots where you can place pictogram cards. Once placed, each pictogram is read aloud through the device's internal speaker. A user can use Ijwi to communicate and practice assigning meaning to each sound and word. We recorded 30 words in English and Kinyarwanda to preprogram Ijwi with. For a list of parts and instructions on how to build an Ijwi please refer to our open repository [1].

APPROACH

We decided to explore different communication solutions with HI through meetings with students and teachers to understand how to best implement a sustainable communication solution. We developed Ijwi, a communication device prototype in the US after exchanging information via email, interviews and remote meetings with our local partners and Rwandan school teachers. We then traveled to Rwanda to hold different design sessions, interviews, demos, and meetings with relevant stakeholders.

To Rwanda we brought three devices that we used as informal design probes to understand what type of communication device was needed and to also introduce the concept of alternative communication in the classroom (figure 2). In addition to Ijwi, we brought two devices that are existing solutions and could be used as baseline comparison: (1) a traditional Picture Exchange Communication Systems (PECS) that we prototyped using a binder, and (2) a GoTalk9+, a touch-based communication device that also uses pictograms displayed on a grid that work as buttons and allows voice recording. We made a set of pictograms to be used equally across all devices to control for the types of words used to try out each one.

Design lessons from the field

Students using Ijwi and the PECS binder required some assistance from others to hold the devices in place as they pulled the Velcro attachments to select pictograms. Perhaps adding suction cups would help but we also realized having it lay flat on a table that is not an angled made devices hard to reach for young students.

We were able to test it on lower tables but reflected on the importance of the space and infrastructure where it would be used and how it would need to be lightweight if students were to carry it home or to school in a daily basis. The GoTalk9+ device which speaks when children press the corresponding button needed a lot of force to be operated. Children had to repetitively push the buttons to make it work. The teachers commented on how the GoTalk9+ was easy to carry around since it had a handle.

Diverse Language and Motor Skills

Teachers suggested different devices depending on each child's ability suggesting the idea of a more modular design. For example, not all students used their hands to write and to point or to grab. One student used his feet to do math, write and even to try out the communication devices (figure 3). Teachers were also very interested in developing different pictograms that did not include academic topics but instead supported more personal conversations such as helping students denounce any type abuse they had experienced.

The teachers are patient and skilled communication partners and they shared that they did not want to lose this connection with the student and the many ways they already use to communicate like sign language. Nonetheless they recognized the value of having the student initiate the conversation and hearing them say something they cannot predict. Teachers also highlighted the importance of the device for students with motor disabilities who had difficulty with hand signs.

Ijwi as a work in progress

Ijwi still has a long way to go, next steps in its design include enabling voice recording so that parents and teachers can program the sounds they want and facilitating the mounting of Ijwi on wheelchairs, tables and desks. We also learned that many students could not grasp the pictograms easily, and although we used Ijwi as a design probe – an early prototype to showcase to the students, teachers and parents what was possible, many of our student testers struggled to properly grasp the laminated pictograms and place them on Ijwi to be read.

Creating a library of sounds and pictograms to be used with Ijwi in different languages is also future work. One open challenge is building a community that continues developing Ijwi to fit their unique context and needs. To support this effort, we have provided appropriate documentation on how to build Ijwi in English but there is a need for the documentation to be translated to different language and to include alternative electronic components that may be easier to access in other countries. The engineering knowledge needed to fabricate an Ijwi might be an additional barrier to making one. To address this knowledge gap, we suggest partnering with local groups invested in making devices such as maker spaces or universities. Partnering with disability experts, teachers, and speech therapists will also be fundamental in developing more robust versions of Ijwi that can support language learning and communication in different ways.

Figure 2. Alternative and augmentative technology we tested in the field displayed from left to right: PECS board, Ijwi, and the GoTalk9+.

Figure 3. A non-speaking student writes a message by selecting pictograms from a communication board using his feet.

In the next section I briefly reflect on some personal lessons learned from the experience of exploring a communication solution for the Rwandan school context.

REFLECTIONS AND OPEN QUESTIONS

In many ways I write this paper as a personal reflection. Developing Ijwi started as a desire to increase the access of assistive technologies in developing countries, in particular in my country of origin Colombia but we had the amazing opportunity to find partners that had the same vision for the beautiful country of Rwanda so we worked with them. I have found that these partnerships are key in being able to develop projects in a new community one is not a part of. In this brief reflection I present some open questions for the ICT4D community regarding: (1) establishing partnership with local organization in a responsible way, (2) evaluating the tension of opportunity and responsibility when working with communities that benefit from our work, and (3) the challenge of identifying when HCI research ends and development work begins and how they can overlap.

Local partnerships and collaboration

This work was possible thanks to partnerships. The partnership with HI was key in our joint effort to bring AAC devices to their education programs. We also contacted universities in Rwanda to talk about how they could support the maintenance of Ijwi devices and iterate on our open-source design. The goals for the project differed from traditional research work in that we originally sought out to develop a product that could be commercialized at some point. In the process, I learned that a connection with local partners and community members is key in being able to understand the complete picture of a problem and the resources in the local ecosystem available to address it. I also learned that it was important for our partnerships to be mutually beneficial and not exploitative. The disability NGO would benefit from the devices and communication technology we developed, teachers could work with us to develop a curriculum that could further communication in the academic context, and Rwandan university students could further their skills as they contributed to a meaningful real-world application. These lessons in mutually beneficial partnership could be further explored through ICT4D work. For example, it has been reported that partnerships between teachers and parents contribute to sustaining and protecting inclusive education projects when they create assistive products together because the product is branded through their own efforts [4].

The tension between opportunity and responsibility

The stakes are high. How do we carry out our research with responsibility acknowledging that as we enter a community we are causing some type of change? What is our role, our responsibility, our commitment to these communities that face multiple needs? During our visit to Rwanda we noticed that technology alone will not support the children in schools. Many of them needed access to health care, speech therapists and other assistive technology products. There are many opportunities for increasing access to assistive technologies, there is so much to do, how can we approach this work responsibly acknowledging that as we step in we are also making a commitment to the communities we are working with?

Balancing HCI research and development work

At the time of this project I was working as a co-founder and designer of Ijwi learning how we could translate Ijwi into a functional product. I am now an HCI PhD student were my goals are to produce academic contributions but it is also my desire to fully engage with the communities I work with and be able to contribute to them through time. How can we balance our HCI research process with the needed development work that often involves maintaining technology, maintaining documentation, and continue to build a community?

CONCLUSION

I look forward to joining a community committed to understanding disability design and innovation in low-resource settings. I also look forward to continue learning how to foster ethical partnerships, carry out responsible research, and find ways to engage and commit to development beyond a product or prototype.

ACKNOWLEDGMENTS

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