

PRACTICE NOTE

Using Technology to Shift Education Paradigms in Low-Resource Environments

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As innovative and exponential technologies make their way into development projects and humanitarian aid interventions, pioneers are just starting to codify and publish their best practices, for example UNICEF's Child-Friendly Technology Framework. Code Innovation designed and lead the Connecting Classrooms project over seven years, bringing technology and education innovations to secondary school students, out-of-school youth and young adults in eleven countries around sub-Saharan Africa. The majority of participants had never experienced being connected to the Internet and there were numerous and ongoing challenges. Using collaborative teaching methodologies and a group learning approach, the program brought young people and their teachers or adult facilitators through a blended learning curriculum around key issues of shared global concern. This paper seeks to expand on lessons learned from the program to make recommendations for others to get the greatest leverage out of technology-supported education initiatives. As there is relatively little research published around multi-year technology for education projects in developing countries to date, this article strives to offer some best practices and lessons learned that will guide similar initiatives in the future.

National education systems are notorious for being difficult to transform. Countries cling to outdated content and ineffective teaching strategies, putting their citizens at a lasting disadvantage. Technological initiatives offer a rare opportunity to fundamentally re-imagine the way that a country educates its young citizens. Under financial pressures, educational ministries quite naturally try to squeeze as much use as possible out of existing text-based resources both at their training facilities and throughout the school system. But fortunately, there is no blueprint or

legacy content in the area of new and emerging technologies for education, giving program architects the opportunity to import and model progressive teaching strategies.

Code Innovation (Code) designed and led a United Nations (UN) communications project that incubated education innovations across classrooms and youth centers in sub-Saharan Africa. The initiative, Connecting Classrooms, targeted secondary school students, out-of-school youth and young adults. The majority of participants had never experienced being connected to the Internet. The project was developed over a seven-year period, starting with the identification of the highest value learning content and the most effective instructional templates. Code's

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education specialist responded to curricular priorities set by UNICEF's communication team, which typically corresponded to large youth conferences or various Millennium Development Goals. Code wrote content that prioritized group work, community engagement and preparations that could be conducted offline. And month over month, Code worked with the open source programmers at we.riseup.net to improve upon the online environment, responding as quickly as possible to user feedback.

Trainings for the program were conducted in person. For a typical training mission, Code's education expert would spend one or two days with a UNICEF country office, briefing staff while training the locally hired, field coordinators. These were usually country nationals recently graduated from university, with some NGO experience or youth facilitation experience. Then the field coordinators would travel with Code's trainer and spend a half-day at each site, training a mixture of school admin, teachers and students. These visits would involve a brief thirty minute run down with heads of school and then a sixty minute preparation with the team of teachers (three to five, usually), and then a training of the students with and by the teachers and the coordinators. By the end of a typical weeklong mission, the field coordinators could complete the training themselves.

Initial efforts were stalled by infrastructure failings or periods when public school teachers' salaries were unpaid for months at a time. The Connecting Classrooms experience, while working on a small scale, ultimately reached beneficiaries in 11 countries¹ and can provide useful strategies for strengthening similar initiatives.

As innovative and exponential technologies make their way into development projects and humanitarian aid interventions, pioneers are just starting to codify their best practices. The United Nations Children's Fund (UNICEF) recently published their first Child-Friendly Technology Framework² with input from Code Innovation. According to

this document, the five central qualities of strong Child-Friendly technology initiatives are: 1) that the initiative be user-centered and equity-focused; 2) that it be built on experience (as opposed to theory and guessing); 3) that it be sustainable; 4) that it be open and inclusive and 5) that it be scalable. Because our content was under constant revision we never published it externally, but we made it available to partners and affiliates in draft form and when requested. All of the technological developments made to the codebase at our request were made available to the wider open source community by our technical contractors.

This paper seeks to expand on this with additional lessons from the Connecting Classrooms program—which unfolded in post-conflict Liberia, the rainforests of Madagascar, unstable and remote Northern Uganda and more than a half dozen other Sub-Saharan African countries. The following are recommendations to get the greatest leverage out of technology-supported education initiatives.

Community Creates Context

Working directly with government teachers who were already living within their larger communities gave the program access to people who understood the community firsthand. Teachers, in most cases, were known figures within the school and the village, city or town, and they knew the family members of their students personally. These connections and the relationships between teachers and their students gave access to qualitative data that fundamentally shaped the program, from its inception. The chief responsibility of our network of field coordinators was to contact schoolteachers on a weekly basis, most usually by telephone but also, on average once every month or two, in person. This frequency of contact made it easier to gather teacher feedback throughout the program and made it more difficult for school groups to stall out during challenges, technical or otherwise. Naturally, some teachers loved the

opportunity to offer meaningful feedback and contributions while others did not.

In remote, rural Madagascar, where partner Non-Governmental Organizations (NGOs) used our program with indigenous communities on the edge of the rainforest, parents of students participated in Connecting Classrooms by attending their own education and technology sessions alongside their children. This wider outreach dramatically increased attendance in the after-school sessions, since parents understood and saw the benefit of their children learning about the Internet, computers and technology.

Meaningfully including all young people in the community in the program was an ongoing challenge, since not all young people had the money or the resources to go to government schools, where books, uniforms and exam fees all cost money. During vacation months, teachers would volunteer their time and assemble small groups of young people who were in town and not out helping on a farm, in the bush or working to earn their school fees. The vacation syllabus encouraged the groups to seek out and include out-of-school youth who otherwise had no access to computers or the program. In that small way, the program attempted to increase equity of program access.

Challenges arose when otherwise motivated teachers became distracted from the program by a stressor in another part of the system. Teachers in Liberia would regularly leave their duties and go to the capital to collect their monthly pay, a journey that in some places took almost a week. Often, a teacher would learn how to lead sessions and then be transferred the next academic year, unable to grow the cohort. Facilitator turnover could be devastating and prompted Field Coordinators to train as many teachers and staff as possible whenever on-site trainings were conducted. The importance of trying to create capable student trainers also became quite apparent, and where there was peer-to-peer education, the program became stronger.

The more Connecting Classrooms sent participants to engage with the community, the greater the likelihood of them establishing connections that would sustain them through demotivating times. Because the program's Field Coordinators worked one-on-one with teachers, it was possible to gather basic information about the surrounding communities from them. This understanding was then used to create tailor-made activities and assignments. These, in turn, helped to raise the profile of the initiative and its stakeholders within their communities.

Understanding the community where you are working is essential. Keeping in close contact with program teachers gave Connecting Classrooms unique access to the users for whom the program was designed. It facilitated the quick and easy return of feedback, allowing the program to pivot where appropriate in the curricular design. School groups that opted out of activities that engaged them directly with the surrounding community were, we observed, more likely to disengage from the program over-all.

Method is More Important than Content

Rapidly shifting priorities caused Connecting Classrooms to change the thematic focus of the curriculum content regularly, drawing the attention of young people to Climate Change, to HIV, or to Agriculture according to corresponding conferences or media events. While it would have been fun to choose these subjects in conjunction with our users, the fact that the program responded to institutional communication priorities meant that our focus was impacted by current events. Fortunately, as we developed a strong repository of past content, we gained the ability to offer choice to our new participants. In the classroom context, this prioritization of content proved distracting and caused the program to lose the momentum and focus that were gained with each new transition. With the support of education specialists, the program refocused on method. We sought

to help people unfamiliar with the Internet to gain the skill sets necessary to help acclimatize to the new digital environment to become on par with most children in high-income countries.

The Connecting Classrooms curriculum used participatory and explorative methodology that was new to both teachers and students. Youth centers were more familiar with the approach and moved more quickly towards running independent sessions without a Field Coordinator present. An oversight in the first semester of Connecting Classrooms was leaping directly into thematic content without spending a few months coaching young people on how to interact with others from distant cultures and how to behave in a digital environment. Ethiopian students wrote German students questions about the Holocaust that sounded accusatory. American students asked the Ethiopians if they were starving and Ugandans asked New York City participants what it was like to be criminals. Since then, new groups worked through mandatory activities that prepared them for the socio-cultural challenges of digital interaction, preventing similar issues for subsequent groups.

Activities introduced classes to the group-networking foundation of the platform, which was built on an open source codebase called Crabgrass. The basic unit of interaction is not the individual, but a group. This allows each classroom to focus on their own group homepage instead of a myriad of individual profiles and to plan for carefully considered group-to-group dialogue instead of scattering across countless windows. The introductory activities give new groups a chance to organize themselves, to practice using computers, and to test the platform. The next cluster of activities explores crucial lessons in cross-cultural communication and problem solving, as well as gender issues faced by girls and young women in schools and in the wider community. After groups complete these introductory activities, they often no longer require onsite supervision,

and are able to lead sessions around issues of relevance to their local communities.

Connecting Classrooms offers opportunities for field trips and interviews with local government and civil society leaders. In every activity, regardless of the theme, young people are sent into the community with a mandate to gather and present clear information about their surroundings. In a 'Food and Agriculture' activity, a trip to the market was accompanied by interviews with sellers about local food networks and prices. In a 'Health' network field trip, young people interviewed a community health worker and asked about the biggest health challenges in the community. In this way, the curriculum supplements the traditional pedagogy of the government schools with participatory firsthand learning. This method also gives the young people an opportunity to be seen as journalists and ambassadors to the larger world.

We developed in-depth participatory content to focus on community building around key global issues. Food and Agriculture was the main topic for almost a year in both English and French, drawing attention from classrooms in Ghana, Ethiopia, and Madagascar. When young people were asked to select their own interests, Health was the primary concern. One Liberian school group in Robertsport wrote articles about teenage pregnancy and interviewed young women in their community about this challenge and how it had affected them. In many cases, the young women interviewed were no longer in school and the young people wrote comments back and forth, between the English-speaking schools, discussing the issue and the root cause of it. In the Earth and Environment section, which was particularly active around the Copenhagen Climate Summit in 2009, young people explored their water sources and learned about environmental health in their communities.

From 2011 to 2013, communities in Madagascar contributed in French and often Malagasy to content related to the Earth and Environment section that classrooms in

other countries followed and commented on by using Google Translate. Throughout the program, groups would use Google Translate to read and comment on posts that were not in their language, and the tool proved useful for facilitating connection between the Anglophone and Francophone groups. In our outreach to potential partners, we always sought to keep a balance of Anglophone and Francophone participants so that both areas would be equally vibrant, just as we sought to keep a good balance of north and south hemisphere schools because of their considerably different academic calendars. This was a challenge that we would eventually have overcome with sufficient growth.

Unexpectedly, in all countries young people had a strong desire to communicate with other classes within their school and other schools in their own country. Different classes in a single school commented repeatedly on each other's work. Most discussions that featured high-quality contributions were conversations taking place within a single country, across many groups and schools, and in one language. It seemed that young people preferred to learn about their proximal neighbors and were more engaged in what young people close to them did and thought. Efforts to create "north-south" dialogue and to foster communications between young people of very different cultural backgrounds were far less successful because the expectations were harder to manage.

Don't Get Distracted by Devices or Upgrades

It is easy to get distracted by the hardware and think that the delivery of content on a US\$ 100 laptop or a basic mobile is what to focus on. The quality of a well-designed user experience holds the stakeholder's attention and engages them in the learning process. Connecting Classrooms relied almost entirely on old PC desktops, in many cases paying ICT technicians to refurbish by harvesting memory from broken ones and consolidating it within those that functioned, reformatting

and cleaning out hard drives, and installing free antivirus software straight from discs before connecting with the Internet to download necessary updates.

The limited number of desktop PCs in the government classrooms and youth centers was a constraint that benefited the program, requiring young people to work together and collaborate in groups. Since most young people in a new cohort did not know how to use a computer, it helped to cluster small groups of four or five around each terminal where they could take turns sharing the keyboard and peering over each other's shoulders. Thanks to the teacher and the promptings of our curriculum, people took turns so that everyone had an opportunity to try. This meant that girls developed computer skills next to the boys (although they did need more initial encouragement), increasing their confidence in ICT and the Science, Technology, Engineering and Math (STEM) fields.

Connecting Classrooms schools and youth centers had full-time access to the Internet provided for the groups by project sponsors, which was the project's biggest capital outlay. Project staff noted the benefits, outside the program, of regular Internet access at the schools. Teachers, for example, looked up and printed out lesson plans and preparation materials for national and regional exams. They opened up and maintained email accounts, allowing them to communicate with program staff, building personal relationships. In the seven-year duration of the program, less than 5 per cent of program hardware went missing or was reported as stolen or destroyed.

We found that getting stakeholders excited about the next wave of technology that would be provided and encouraging them to anticipate greater ease and function was counterproductive. Rather than motivating them, it gave stakeholders a reason to limit their exertions in the present, in order to wait for some future that they did not control. The way that the program staff spoke

about a community's available technology was significant and directly impacted program enthusiasm. If staff found faults with the local technology, complained about the electricity, the irregular connectivity, the bugs of their operating systems, or the age of their computers, it decreased the pride stakeholders took in their own resources. These attitudes could create a mindset that looked for excuses and saw, even amidst relative abundance, scarcity and limitation. It was important to celebrate what stakeholders had and to speak positively about what they would be able to accomplish with it.

Another observation specific to technology initiatives was that it was important to be on guard against attitudes towards technology updates and upgrades that are prevalent in high-income countries where tech users regard these as inevitable conveniences. An office IT department working full time, releasing new features every couple of weeks might be appreciated by digital natives on fast connections. For Connecting Classrooms users, staff found that even simple changes to the User Interface would cause widespread confusion and critically demotivate teachers. The program worked best when upgrades were limited to once a year and facilitators were trained rigorously around each modification.

Offline, No-tech Activities are a Critical Foundation for Technology Initiative Success

Connecting Classrooms designers realized that for every lesson plan and every step in the curricular progression, there had to be a complimentary robust offline component, something participants could complete when the infrastructure was not cooperative or available. For large classes where access to machinery was limited, this enabled some students to work with technology while others performed complimentary efforts that could be done offline and online.

Collaboration was at the core of all content. Limited computers meant students shared a desktop PC in small teams of, ideally, four

or five learners. The team with the digital camera was often popular as students appreciated the opportunity to approach their community as citizen journalists. Even when the electricity was unavailable or the Internet wasn't working, the syllabus provided offline activities. It was vital for participants to feel that circumstances outside their control (like electricity shortages or poor connectivity) were no obstacle to participation.

In Liberia, the plan for the Field Coordinator was to perform bimonthly field visits to each participating school. In practice, the visits stretched to one per month and became even less frequent during rainy season. The program learned to plan for total technology shut downs during periods of tough weather. One school in Nimba County in the conflict-prone Mano River region went offline for weeks at a time during rainy season, the signal never making it to their school. But when they finally came back online, they had a backlog of material to post and they rejoined the community with pride.

Always Consider the Teacher a Primary Beneficiary

Connecting Classrooms supplemented national curriculum with thematic content and teachers were trained to integrate the platform's curriculum into their standardized lesson plans. English, science and IT teachers took full advantage of the program's linkages with their own curriculum and in some schools took over leadership of the weekly sessions.

Teachers were the hinge upon which program success was leveraged. If a teacher was willing to try new things in the classroom, success was far more likely. If not, the program would over time slowly go quiet online and the flow of information from the field would drop off. Long-term program success also needed administrative buy-in, so each Field Coordinator visit included a stop by the principal's office to check in and share progress. Where teachers and administration were deeply invested in the best interests of the students, the program was able to work

through its challenges. Where systems and supervisory structures within the education system were already broken, however, it was not as easy. Keeping teachers motivated in the face of infrastructure and institutional challenges was one of the more difficult parts of the program. Two free and simple ways to support and to motivate teachers were incorporated: giving certificates for quality participation and praise, especially in writing, to their supervisors. When teachers knew that they might receive formal praise and recognition for their efforts, they were often more motivated.

The technical challenges for teachers to learn computer and Internet literacy were high. Often, teachers felt self-conscious and were reluctant to try new things in front of their students—especially in the presence of students who had already achieved high levels of computer literacy. It was crucial for Field Coordinators to establish personal relationships with the teachers and to spend time during visits building their confidence and skills before the sessions when students would be present. Investing the extra time into equipping the teachers to explicitly assist with student trainings generally resulted in stronger performance.

Partners Create Sustainability

The most successful Connecting Classrooms initiatives had the support of local NGOs who were already working with young people in communities and wanted to include networking and educational programming through the technology. In the conflict-prone regions of northern Uganda, a group called Battery-Operated Systems for Computer Outreach (BOSCO) ran solar-powered computer labs that used the curriculum developed by the Connecting Classroom initiative in their youth groups for years. There were clear benefits of having local partners implement and lead the project. Since they already worked with young people in their communities, they had access to decision-makers and youth leaders that enabled them to work at scale.

Where government schools were hierarchical or crumbling under the weight of unpaid wages or too few teachers, it was hard to make the program grow. Long-standing, locally run NGOs provided helpful support in these instances. Similarly, the dependable focus and mission statement of local NGOs was a strong buffer against the changing priorities and irregular funding commitments of larger entities.

One opportunity that was difficult to realize was a partnership with a mobile network operator (MNO) who would charge a favorable rate for monthly Internet connections to the schools and youth centers. Attempts that were made to partner with the Corporate Social Responsibility departments at multinational corporations were without success. The MNOs did not seem interested in assisting with providing free connections, or in benefiting from program publicity. Internet connectivity at participating sites composed a significant part of program expense for the duration of Connecting Classrooms. As the program grew, we emphasized selecting government schools that already had some rudimentary Internet access, as the alternative of providing connectivity depends on too many variables that are hard to control from a distance.

Budget Yourself Out of Business

Throughout the program, Connecting Classrooms sought to create content strong enough to keep partners using the material long after the program staff stopped coordinating their involvement formally. The goal was to train and hire local developers to fix problems and to issue updates, whenever possible. The number of coders and programmers in low-income countries was and is growing, and many are self-taught. Crabgrass programmers used a computer language called Ruby on Rails, and coders were available in Senegal, Ghana, Kenya and elsewhere in the region to create local customizations and platform-wide changes, as and when desired.

A key benefit of activities that prompt students to reach out and include the wider

community is that they may generate connections that sustain the program when pilot funding ends. For example, encouraging school groups to interface with Internet café operators or with youth associations that use other tech resources in the community may result in future access for those students. Partners that continued program implementation several years after the program stopped funding their Internet and other program costs all had forged connections with other tech facilities and labs.

Monitoring and Evaluation

The data received from monitoring the site's numbers and getting regular qualitative feedback from Field Coordinators helped shape a lightweight and scalable program, even if it did rely heavily on weak infrastructure and a large face-to-face investment during start-up.

When program architects have the option to build monitoring tools into their online environments, these programs have a distinct advantage. Curriculum developers wanted to know which parts of the site were being visited most frequently and which were being ignored. It was also helpful to observe how many accounts were active in creating pages together and what sort of posts generated the most interactions.

There is growing academic literature about the impacts on young people of engagement with technology—especially in the context of low-income countries. Connecting Classrooms worked closely with social scientists over the seven years of the project to

create new metrics for measuring the impact of technology programming. In general, the academic community was quite receptive to opportunities to collaborate around survey design and analysis.

Conclusion

Best practices in designing tech-supported education initiatives in low-income countries are improving rapidly. Connecting Classrooms gave an opportunity to apply innovations in education directly to low-resourced classrooms and youth centers and built years of experience measuring their impact. While the program did not have the means to measure changes in the quality of education in the places where the program was implemented, it did observe a measurable shift towards participatory teaching methodologies and increased collaboration in the classroom. The program also noted higher levels of community involvement and an increase in purposeful interactions between school children and out of school youth. New technological initiatives continue to offer an ideal opportunity for pioneering the integration of new educational paradigms where they are most needed.

Notes

¹ Canada, Germany, Ghana, Ethiopia, Kenya, Liberia, Madagascar, Rwanda, Senegal, Uganda and the United States.

² See: http://unicefstories.files.wordpress.com/2013/08/child_friendly_technology_framework.pdf

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