Dear Reader,

I’m delighted to share with you the sixth edition of the Jefferson Public Citizens (JPC) journal. Launched in 2009 at the University of Virginia, the JPC program combines academics with public service and offers an intensive undergraduate student research experience. JPC serves as a catalyst for students who seek to build upon coursework, create knowledge and become active citizens for the public good. JPC student-teams partner with University faculty and with local, national, and international communities, in an effort to address identified societal needs.

The purpose of this journal is for students to reflect on their research-service projects and contribute to the production and dissemination of knowledge in their field. The participants of JPC engage in a deep and sustained level of reflection about their service work through academic writing. They come to understand how both the research and service elements of their project can inform the issues with which they are grappling. Through collecting data, analyzing their results, and discussing their findings, students learn how to situate their service work in a broader context of scholarly knowledge about their topic.

This journal is a culmination of the students’ hard work and reflection on their projects. The teams began working on their proposals in the fall of 2013. After receiving funding, they prepared for their projects through orientations, meetings with their faculty advisors and community partners, and hours of planning. After completing their research, they analyzed their data and began making sense of their findings. They participated in a peer advising process and shared their drafts with their faculty advisors. Their manuscripts were reviewed by a committee consisting of faculty, administrators, alumni, students, and community members. The students received feedback and then submitted their final articles.

The articles in this issue explore big issues including education, health care, and access to clean water. They demonstrate the passion, effort, and commitment of our JPC students, graduate mentors, faculty advisors and community partners. I hope you will enjoy learning about their exciting and inspiring work.

To see personal testimonials of the JPC experience, please visit our website (http://www.virginia.edu/jpc/) and find links to short videos of our alumni and faculty. On behalf of the JPC students and administrative team, I wish to thank the faculty advisors and proposal and journal review committee members who help make these exceptional opportunities possible.

Sincerely,

Brian Cullaty
Director, Jefferson Public Citizens Program
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Evaluation and Expansion of an Interprofessional Community Health Worker Training Program in Limpopo, South Africa

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Faculty advisor: Associate Prof. Cathy Campbell, PhD, APN-BC
Local Partners: UNIVEN Nursing Faculty, Johnny Bvukeya, Chily Thanyani, Gloria Shibambu, Limpopo Department of Health and Tiyani Health Center Staff

The worldwide healthcare worker shortage has led to the education and empowerment of community health workers (CHWs) to aid in the care of communities. The purpose of this study was to evaluate the effectiveness of the 2013 hypertension and diabetes pilot training for CHWs in Limpopo, and to implement a 2014 training curriculum. Twenty-four self-selected CHWs participated in two days of training at a rural clinic, 23 of whom attended the 2013 pilot training. Training day 1 included a motivational interviewing workshop and evaluation of the pilot curriculum using surveys, group- retained knowledge, and focus groups. Training day 2 included workshops on asthma, pharmacy literacy, and motivational interviewing (MI). Pre- and post-knowledge assessments of the group were conducted and surveys were completed for evaluation of Day 2. Over 90% of the CHWs applied gained knowledge and skills from 2013 when counseling patients and found the information from 2014 applicable and 75% reported they will do things differently based on gained knowledge. The motivational interviewing survey showed that 92% would use the MI skills in their daily work and 100% would be able to provide better care to their clients. These results suggest both training programs increased the knowledge and competency of the CHWs. Future research will entail collection of baseline data on prevalence and health outcomes related to the training topics, and will provide further training in motivational interviewing.

Introduction

Limpopo is a predominantly rural province in northern South Africa challenged with poverty, limited access to healthcare and clean water, the HIV/AIDS virus, and the growing burden of non-communicable diseases (Mayosi, 2009; Powell, 2009). There is a healthcare worker shortage of about 4 million worldwide, and a nursing shortage of above 60% in Limpopo, South Africa (WHO, 2010; Health systems trust, 2011). Therefore, there is a renewed emphasis on educating and empowering community health workers (CHWs) to deliver care and information to community members, since they interact with community members more frequently than doctors and nurses (vanGinnekin, 2010; Perry, 2012).

The CHW programs are cost-effective interventions used to improve the health of disenfranchised rural communities by providing health education to community members, promoting prevention of health issues through lifestyle changes, and providing counseling for general well-being (Arvey & Fernandez, 2012). Because the
CHWs are members of the communities that they serve, the education and counseling styles are delivered to their patients in a culturally relevant way (Arvey & Fernandez, 2012). The CHWs also act as a liaison between people in the community and health care providers and services because they visit patients in their homes and report back to the health clinics (Arvey & Fernandez, 2012). Additionally, CHWs play a vital role in aiding in the post-apartheid political shift in South Africa to reorient services towards primary health care (Chopra et al., 2009).

The Community Health in Limpopo (CHIL) project builds on the prior work of the existing Water and Health in Limpopo (WHIL) collaboration between the University of Virginia (UVA) and the University of Venda (UNIVEN). CHIL was created when the local health department expressed a need for education of CHWs. As a result, UVA and UNIVEN formed an interdisciplinary team of undergraduate and health professions students, health professionals, and faculty that designed, implemented, and evaluated the first 2-day training program on diabetes and hypertension for CHWs in two rural health centers in the Limpopo province (Plews-Ogan, 2013). The CHIL 2013 team trained 60 CHWs, and a subset of 30 provided written feedback on their satisfaction with and perceived effectiveness of the different learning activities. CHIL 2014 builds on the foundation of the CHIL 2013 pilot training program.

The CHIL 2014 team returned to one of the rural health centers that participated in the pilot program, and the same 24 CHWs that participated in the pilot training program returned. The CHIL 2014 project had three objectives: to evaluate the retention and application of knowledge, skills, and resources from the 2013 pilot training program; to collect baseline outcomes data related to chronic disease; and to develop an improved training curriculum for 2014.

**Methods**

In collaboration with seven undergraduate students from UNIVEN we began our study at the Tiyani Health Center. Twenty-four CHWs participated in our study. Twenty-three of CHWS were members of a 24 person cohort who attended the CHIL trainings in the summer of 2013. The UNIVEN students reviewed the curriculum to ensure that it was clear and culturally appropriate. They also translated dialogue during each session and led a motivational interviewing (MI) session in the Xitsonga language. Before the first session, the CHWs reviewed and signed consent forms.

Data collection and the didactic portion were split over two days of training. Training day one focused on evaluating the previous year’s curriculum. During day two, we conducted three different teaching sessions, which we developed using the feedback that the CHWs provided on day one. The same 24 CHWs were present at both sessions.

During the morning of the first day of training, half the participants (12) were split into two focus groups of six each. The other 12 participants completed a motiva-
Motivational interviewing was selected as a new skill because it is a validated technique for supporting behavior change in patients with chronic disease. MI is a skill that builds on the education and counseling skills that the CHWs already use with their clients.

In the focus groups, the participants completed a survey in English assessing how often they used the skills, knowledge and resources from the 2013 CHIL Training (Plews-Ogan, 2013) in their daily work with clients.

Knowledge retention of diabetes and hypertension content from 2013 were assessed using word webs (concept maps) (Nesbit & Adesope, 2006). The diabetes and hypertension word webs each evaluated definition, signs and symptoms, risk factors, and management. Answers were provided only by the CHWs and we used the accuracy of those answers to determine how much information they retained from 2013.

The focus groups also included questions that identified preferred methods of learning and new topics for 2014 trainings. These sessions were recorded and transcribed. Two new topics were identified – asthma management and pharmacy literacy.

We created a lesson plan based on this dialogue and returned a week later for implementation. The class was taught by UVA and UNIVEN students together. We held sessions about asthma management and pharmacy literacy, and a second session on motivational interviewing skills. During the Asthma Management session, we reviewed pathophysiology, signs and symptoms, and management, using a combination of lecture and hands-on demonstrations. CHWs also received a durable “Asthma Client
Education Guide” which they could use in their daily work with clients.

The pharmacy literacy class focused on identifying medications, dosage, and scheduling for common medications to treat asthma, hypertension, and diabetes. The range of activities was similar to those used in Asthma Management.

The second motivational interviewing workshop was run by two UNIVEN students in Xitsonga. They role-played different MI scenarios related to different chronic health problems to demonstrate how to use appropriate MI-style phrases. The CHWs received a laminated copy of the motivational interviewing guide with the MI framework and example of phrases in both English and Xitsonga.

Training day 2 was evaluated using a survey composed of a combination of multiple choice and short answer questions. Results were analyzed using descriptive statistics. Narrative responses were analyzed for the presence of themes related to the training curriculum.

Results

Tables 1 and 2 provide a summary of the survey results given to the CHW focus groups inquiring about HTN and DM skills and knowledge retention from the 2013 CHIL Training.

<table>
<thead>
<tr>
<th>Questions: How often have you...</th>
<th>Never</th>
<th>1-2 times a year</th>
<th>1-2 times a month</th>
<th>1-2 times a week</th>
<th>Almost every time I visit a home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worked with HTN patient</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Counseled HTN patient on diet</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>96</td>
</tr>
<tr>
<td>Discussed Medication Adherence</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>96</td>
</tr>
<tr>
<td>Check blood pressure with cuff</td>
<td>46</td>
<td>0</td>
<td>13</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>Referred patient to clinic or hospital</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>72</td>
</tr>
<tr>
<td>How often have you used the Hypertension “Action Plan” (Handout)?</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>92</td>
</tr>
</tbody>
</table>

*Table 1: values rounded to the nearest percentage.*
Table 2: Diabetes Mellitus (DM) Skills and Knowledge Retention (percentages)

<table>
<thead>
<tr>
<th>Questions: How often have you...</th>
<th>Never</th>
<th>1-2 times a year</th>
<th>1-2 times a month</th>
<th>1-2 times a week</th>
<th>Almost every time I visit a home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worked with a patient with DM?</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>96</td>
</tr>
<tr>
<td>Counseled a diabetic patient on improving their diet?</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>92</td>
</tr>
<tr>
<td>Talked to a diabetic patient about taking their Glucophage/Metformin?</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>92</td>
</tr>
<tr>
<td>Inspected a diabetic patient’s feet for cuts wounds?</td>
<td>20</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>64</td>
</tr>
<tr>
<td>Referred a patient to a Health Clinic to be tested for diabetes?</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Used the Diabetic “Action Plan” (Handout)?</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>96</td>
</tr>
</tbody>
</table>

*Table 2: Values rounded to nearest percentage.

The word webs on DM and HTN assessed the knowledge and recollection of the CHWs from the 2013 pilot training. There were some similarities between the results of the focus groups. Each focus group defined and identified the signs and symptoms of diabetes with ease. However, the CHWs were less knowledgeable regarding the medications needed for type I and type II diabetes. Without facilitator prompting, the participants were able to define healthy vs high blood pressure (BP), identify risk factors, as well as list interventions to reduce high BP. Knowledge deficits regarding the identification of long-term complications and common medications used by hypertension patients were noted. In all of the groups, the CHWs reported feeling comfortable with diabetes and hypertension.

Tables 3-5 show the results of the Training Day 2 survey that inquired about the enjoyment and usefulness of the information taught throughout the day.
Table 3: Participant Responses to 2014 Training Day 2 Survey (percentages)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>After the session I feel better able to help my clients</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>96</td>
</tr>
<tr>
<td>I can use the information I learned in my daily work</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>96</td>
</tr>
<tr>
<td>With this new information there are things I will do differently</td>
<td>0</td>
<td>17</td>
<td>0</td>
<td>4</td>
<td>75</td>
</tr>
<tr>
<td>The presentations and materials were effective for my learning</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>92</td>
</tr>
</tbody>
</table>

*Table 3: Values rounded to the nearest percentage.

Table 4: 2014 Training Day 2 Survey

<table>
<thead>
<tr>
<th>Question</th>
<th>Asthma</th>
<th>Motivational Interviewing</th>
<th>Pharmacy Labels</th>
<th>All Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of the three topics reviewed today, which will be most useful in your daily work?</td>
<td>46</td>
<td>8</td>
<td>17</td>
<td>38</td>
</tr>
</tbody>
</table>

*Table 4: Values rounded to nearest percentage.

Table 5: Participant Responses to Motivational Interviewing

<table>
<thead>
<tr>
<th>Question</th>
<th>Percentage that strongly agreed with each statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI training will be useful in my daily work</td>
<td>92% (22/24)</td>
</tr>
<tr>
<td>MI will help me provide better care to my patients</td>
<td>100% (24/24)</td>
</tr>
</tbody>
</table>

*Table 5: Values rounded to the nearest percent.

In regards to Training Day 2, the CHWs were very appreciative of the lessons we taught on asthma, motivational interviewing, and how to read pharmacy labels. They reported that they would utilize the information they have learned in their daily work. Verbal comments from the participants included:

“This is so wonderful, successful and marvelous. It’s like when I have salvation. I feel so grateful over this workshop-it makes me feel so happy. Thank you!”
“Thanks so much. Go around the world and give that information. We are going to help our patients and community at large, well done.”

Discussion

We achieved two of our three research goals. We were unable to collect any baseline patient outcomes data related to diabetes, hypertension, and other chronic diseases. Outcomes and incidence data exists at the clinic/community level though we were unable to process this data due to insufficient time, manpower, and limitations of a paper based system. The collection of this baseline data will be one goal for a team planning to return in summer 2015. Establishing this baseline is essential to the long term sustainability of this collaboration, as we hope to assess for improvements in outcomes and adherence.

We were able to evaluate the CHIL 2013 pilot curriculum. As shown in Tables 1 and 2, the HTN skills, DM skills, and knowledge retention were high. Of note, only 30.4% measured BP on almost every visit. We were encouraged by these results, though we believe that the language barrier may have led to the possible misinterpretation of the English survey questions, potentially skewing the results to “agree” or “strongly agree.” Taken in combination with the word-web results demonstrating the CHWs ability to identify the signs and symptoms, definitions, risk factors, and interventions to manage HTN and DM, we believe that the CHWs retained sufficient knowledge and skills from the 2013 training.

Our final goal was to deliver a new CHIL 2014 curriculum. The CHW focus groups identified a strong desire to learn skills that they could use to directly help their clients, which led to creation of lessons on motivational interviewing, asthma management, and pharmacy literacy. Evaluation of the second training day showed similar high levels of satisfaction and usefulness of the material (Table 3).

The narrative survey responses suggest a strong desire for further motivational interviewing training and practice, particularly in the local language. The CHWs also indicated a continued desire for practical skills, hands-on activities, and role-playing activities in local languages for future instructional sessions. The department of health and professional nurses showed enthusiasm for the potential of motivational interviewing techniques to improve patient adherence and outcomes.

UNIVEN, UVA Center for Global Health, and the Limpopo Health Department all are supportive of this continued collaboration and planning for the 2015 project has begun. The 2015 CHIL collaboration will present MI as a central skill that can be used to help manage any chronic disease where behavior change is a component of improved health, including diabetes, hypertension, asthma, and medication adherence. We believe that our bilingual training curriculum and MI guide serve as an excellent framework for expansion to other communities. The 2015 team also intends to re-
view the topics taught in previous years, collect community level health outcomes data, and do field observations.

While we only were able to train 24 CHWs, we believe that the learned skills and durable client education guides will be useful in their work and that there is enthusiasm for future sessions. Our greatest limitation was that this project only provides a snapshot of the CHW experience. We were not able to observe the CHWs working with clients and applying skills taught in 2013 or in the current training. While the CHWs reported using the provided materials almost every day, we have no way of verifying this at this time.

Language barriers continue to be a challenge as well. While the health department desires training and materials to be in English, the CHWs were much more comfortable in their native languages. While we were able to modify our lessons, our sessions were still reliant on parallel translation by UNIVEN students. This also complicated collection of survey data, since the surveys were in English.

Finally, to make this project sustainable, we propose adding a train-the-trainer component to future collaborations, so that professional nurses could implement our training curricula in multiple communities. By building capacity, we also hope that the CHWs would have opportunities to review these skills multiple times per year and receive local feedback from their trainers. We would also like to institute a variety of data collection methods, especially participant observation to evaluate the application of training content.

References

A multi-part investigation was carried out to determine the water security of an indigenous community in rural Guatemala. Details on the water system, such as GPS coordinates, pipe size and material changes, terrains and elevations, hazards, and spigot pressures were collected and compiled in a GIS map. Interviews were conducted with community leaders to gather information on the community’s water infrastructure, maintenance and history. Of 110 households in the community, 80 were interviewed regarding their individual water usage and satisfaction. The investigation revealed several issues, like potential pump failure, an inadequate community collection tank, inconsistent water pressures among household spigots, PVC pipes suspended over ravines, and exposed and dirt-filled community pipes. In addition, the gravity-fed community pipe network does not have large enough altitude changes to create adequate water pressure for all households. Short and long-term recommendations were given to the community leaders based on financial cost and temporal urgency. Leaders were empowered to utilize this comprehensive analysis as a tool in deciding how to address water infrastructure issues in a sustainable manner.

Introduction

Clean, safe water is a scarce resource in countries across the globe. In Guatemala, for example, political instability and government corruption have made it difficult for all citizens to access clean water, a universal human right. (Benson 2008). In the rural areas, only 15 out of 331 municipalities have a treatment plant that works properly (Vásquez, 2011). Contaminated drinking water causes many detrimental health effects, including nausea, fever, diarrhea and serious immune, neurological, developmental, and reproductive problems (PSR 2009).

University of Virginia - Guatemala Initiative (UVA-GI) staff and students have partnered with the community of San Martin since 2012, implementing a water health education program followed by the installation and maintenance of point-of-use Hydraid biosand filters in each family’s home.

In the 1970s, American engineer Bruce Clemens (associated with the NGO Agua del Pueblo) and a team of volunteers designed and constructed the water system that currently pumps water from Lake Atitlan to the tank of San Martin, from which gravity carries the water to each home (Karp 1999). The community continues to rely on this infrastructure to meet their water needs; however, the quality and quantity of water reaching the community is no longer sufficient.

In the spring of 2014, the community leaders of San Martin sent the UVA-GI a proposal to collaborate in moving their water pump from its current polluted location
near the shore of Lake Atitlan to a location with clean water. However, before we arrived, this pump failed, forcing the community to install a new pump, which was placed in a deeper and clearer part of the lake. Despite the new location of the pump, many issues remained with the water infrastructure of San Martin. Our in-country partners advised us to examine the effectiveness of the complete water infrastructure from the source to point-of-use. Analyzing the entire system, not just the apparent problems, is the best way to correctly increase gravity-fed water system capacity (Mihelcic 2009).

The community leaders, the UVA-GI, and our team hoped that our multi-part investigation would identify and prioritize key issues existing over the entire system while leaving the decision-making in the hands of the community. Such involvement in development initiatives both empowers communities and results in more effective and efficient projects (Honkalaskar 2014).

Methodology

Both qualitative and quantitative methods were used to make an evidence-based evaluation of the water infrastructure of San Martin.

The primary qualitative tools utilized were in-depth interviews with community leaders, local engineers, and University of Virginia staff, as well as surveys of community members. Interviews with the community leaders and local engineers were conducted to gather descriptive information about the history, maintenance, current issues, and local pricing relating to the water system. Skype interviews with UVA’s Dr. Aaron Mills (Environmental Sciences professor) and Mr. Eric Anderson (Chemical Engineering lecturer) assisted us in drawing conclusions from the data and information gathered. Community member surveys were administered verbally (with an in-country staff member who translated between Spanish and the community’s language of Kaqchikel). We were able to conduct interviews with 80 of the 110 households. The purpose of these surveys was to estimate daily water use, understand supply issues at the individual level, and identify general trends in community perception of the water system. All answers were coded into categories and general trends were noted.

The quantitative aspects of the research process included creation of a GIS map and the measurement of water pressure in individual households. First, using a Garmin GPS device and the guidance of community leaders, the team walked the length of the pipeline from the pump in Lake Atitlan to the storage tank located on high ground at the edge of the community. GPS coordinates and altitude measurements were taken at points of interest including valves, changes in pipe diameter or material, and potential areas for improvement. As part of the in-home surveys, interviewees were asked to fully open their faucet and we timed how long it took to fill a 1 liter bottle. The latitude and longitude of each house surveyed was also recorded. A map of
the households was created and linked to survey data to discern if any geographical patterns existed in water supply between households.

**Results**

We divided our findings into four parts: the pump in Lake Atitlan, the pipeline to the community, the collection tank, and the in-community piping.

**Pump:**

The current pump is designed to move 28 gallons of water per minute, with a 3 horsepower, 220 volt engine. During our interviews, 46% of community members expressed concerns about a potential pump failure leaving the community without water. A new pump costs approximately $1,570.

**Pipeline:**

According to the survey results, 24% of the community expressed concerns about the pipeline that carries water from the lake to the community tank. The community leaders expressed two concerns about the pipeline: first, they were concerned that the narrow 2-inch pipes at both ends of the system were inhibiting the flow of water; second, they were concerned the PVC piping suspended across several ravines was a weak link in the system—these parts of the pipeline have broken several times in the past. The locally available alternative, galvanized iron piping, is almost six times more expensive than PVC ($100 opposed to $17 per 3” tube). The support columns would cost about $660 each or about $400 if the community contributed materials and manual labor (F. Juarez, personal communication, July 28, 2014).

*A pipe crossing over a ravine between San Martin and Lake Atitlan*
**Tank:**

Community members were also very concerned about the size of the tank, 45% expressed that the perceived small size of the tank was limiting the water supply to individual households. It was reported, however, that the tank (with a capacity of 22,500 L) regularly overflows by mid-afternoon. The capacity of the tank is supplemented by the “dead space” of the pipeline, which exists after the point of highest altitude in the system, from which water will be carried by gravity into the tank as it is emptied by community use. By calculating the length of the pipeline the “dead space” was calculated to hold 13,828 L. The daily community water usage was estimated from interview responses to be about 25,000 L. The desired 50,000 L tank was quoted at $9,800 (F. Juarez, personal communication, July 20, 2014). Nearly half (46%) of families had some form of in-home water storage, such as a 55-gallon drum or a rain collection tank.

**Community piping:**

Regarding daily water supply, 19% of interviewed households had major supply issues, such as only getting water a few times a week while 41% of the community reported problems with water pressure and blockage, and when measured during interviews, household water pressure varied greatly from 28.4 liter/min to 4.15 liters/min.

There is a thick buildup of dirt, debris, and rust inside the pipes, greatly decreasing the pipe capacity.

Additionally, 48% of the community said that when they turn their spigot on for the first time in a day, the water is dirty or yellow.

**Discussion**

The people of San Martin are fortunate to have a water system that delivers water to their homes.
However, our findings reveal that not only is the supply barely adequate for the needs of the residents, but that the water system has many weak points that could lead to failure significant enough to shut down the system.

Our research results in several recommendations for potential improvements based on engineers’ opinions, financial cost, and temporal urgency. These recommendations were delivered to our in-country staff to help them decide how to address and prioritize infrastructure issues in the future. Decisions will depend on the community’s resources, priorities, and initiative.

Considering the pipeline distance and altitude changes, the current pump is sufficient to transport water from the lake to the community (E. Anderson, personal communication, July 15, 2014). It is unlikely that it will malfunction in the near future, considering the pump is only four months old, but the possibility still exists. Having a new back-up pump in reserve could be useful considering they are not readily available near the community. However, the cost of a new pump would put a large financial burden on the community.

With regard to the pipeline concerns, while a uniform pipe diameter is optimal, the 2-inch pipes are sufficient considering the power of the current pump (E. Anderson, personal communication, July 15, 2014; Mihelcic 2009). Additionally, these pipes are buried underground and thus are currently protected against mechanical damage and problematic temperature changes (Arnalich 2010). The PVC pipes crossing the ravines are not properly supported and could break in a storm due to debris or under the pressure of their own weight. As such, it would be ideal to replace the PVC tubes with galvanized iron and construct two concrete supports to hold the pipes in place (E Anderson, personal communication, July 15, 2014; Arnalich 2010). However, the existing PVC pipes are functioning satisfactorily, and if they do break, replacing them with more PVC is easy and inexpensive (Mihelcic 2009). An alternative solution would be to add support to the existing PVC.

The community’s biggest concern was community water storage. However, the capacity of the current tank already achieves 30-40% of the community’s daily water use, which should be adequate considering the constant flow of water from the pump throughout the day (Simpson 2003). The observation that the current tank regularly overflows also serves as evidence that its size is sufficient for the community’s needs (Mihelcic 2009). It is true that in the event of pump or pipeline malfunctions, the current capacity of the tank would not be large enough to support the community’s water needs for multiple days, but a larger tank would be very expensive for the community. A cheaper alternative would be to encourage emergency water storage within the community by purchasing containers for community members who do not already have them (Mihelcic 2009).

In order to improve water delivery to individual households, the community pipes would need to be replaced, because cleaning PVC pipes is very inefficient (E An-
In addition, redesigning the pipe system in order to take better advantage of the effect of altitude changes would improve water pressure delivery to homes. An entirely new system would require a large investment, costing approximately $2.09 per 6 M x 1/2” PVC tube and $7.58 6 M x 2” PVC tube plus connectors and glue. Given the length of the in-community pipeline, this would cost close to $2,500. Alternatively, the community could focus only on the PVC pipes which have been improperly manipulated using heat to round corners and form unions. This reduces the diameter and flow rate inside of the pipes and creates greater potential for leaks and contamination. These problems could be remedied with the purchase of new connections and small sections of pipe at a much lower cost than a complete replacement of the system.

Some limitations were possible in our methods. Many of our data were collected through conversation, so misunderstandings were possible between our Spanish and the community’s language, Kaqchikel, despite the presence of a translator. Lack of knowledge regarding the system at large, or error in memory, may have influenced their answers. We did our best to avoid much of this by cross checking information with different sources (e.g., physical data). GIS map altitude changes were possibly miscalculated due to +/-10m error margin intrinsic to the GPS’ barometer (Arnalich 2010), and much of the pipeline map was created on the community leader’s spoken recollection since much of it was buried or inaccessible. Water pressure could not be effectively compared at all households, due to variation between spigots (in particular, presence of a hose significantly decreased pressure). Despite these limitations, our conclusions are grounded by multiple types of data and by consulting with several different professionals that helped us to develop sensible solutions.

We have delivered our findings to our community partners, and are anticipating the results of UVA-GI’s conversations with the community leaders. We have seen firsthand how dedicated San Martin is to their water and community health. In interviews, many community members expressed their concerns about the current infrastructure and hopes for the future; they also praised the community leaders for having worked tirelessly to improve both the quality and quantity of water, especially in the past year, despite limited resources. Given the dedication of the community members, the community leaders, and UVA-GI, we are confident that positive and sustainable changes will be made to the water system, and we hope that our data will play a helpful role in the improvement of San Martin’s water infrastructure.
References


 Biographies

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Addressing Water Quality and Aqueduct Efficiency in El Corozo, Dominican Republic

Irene Burgoa, Katelyn Ditzler, Kathryn Hendley, Kelsey Hunt, Andrea Parra, and Leigh Robertson

In response to an expressed need for a potable water system in the community of El Corozo, Dominican Republic, this JPC team continued the installation of a water system funded by a previous JPC team. With guidance from Daniel Saboe, a Peace Corps volunteer, and in partnership with a local NGO, REDDOM (Rural Economic Development Dominicana), the team worked to improve both the quantity and quality of available water. To increase the amount and availability of water in the system, the team modified the original intake structure and installed tap stands. We improved water quality by the successful installment of a sedimentation tank, a chlorination system, and a reforestation effort. Concomitant results included: initiation of a legal process that will provide El Corozo official operational and sanctioning power over the aqueduct, construction of an additional deposit tank, and implementation of a barbed wire fence to contain livestock and prevent pollution.

Introduction

While it is known that water is a daily necessity for humans, water quality importance is sometimes underestimated. Access to safe water is one of the most effective methods to prevent illness and disease, and improves lifespan and health more than any other advancement in the field of medicine (Meinhardt, 2013). Yet 17% of the global population lacks access to clean water, and unsafe water accounts for 10% of the global burden of disease (Meinhardt). *Escherichia coli* (*E. coli*), a common gut bacterium, is one such diarrheal illness in which some strains lead to other bodily infections that can be life threatening (Tidy, 2014).

El Corozo, a cluster of seven rural communities in a cocoa-producing region of the Dominican Republic, falls within the 20% of the rural Dominican population lacking improved drinking water sources (UNICEF, 2011). Daniel Saboe, a United States Peace Corps volunteer, initiated the creation of El Corozo’s water system in 2012 with the support of REDDOM, a Dominican NGO that carries out national rural development projects. A 2013 JPC team collaborated with the two to install a gravity-fed aqueduct to provide water to 350 of about 500 households in Corozo (estimating an average of 5 people per household). The local Water Committee ruled that households must opt to participate in the system by providing labor hours or paying for access. Others still collect rainwater or walk to rivers for daily use. The 2013 team established the fundamental pipe network of the system, while our team addressed select structural and water quality issues. We responded to problems of intake structure clogging that prevented water entry into the system, high sediment load, and concerns of *E. coli*
and fecal coliform contamination in the water supply. Partnerships from past years continued during project implementation.

**Methods**

Prior to arrival in El Corozo, the 2013 team and Saboe provided contextual and technical background. Although these conversations provided significant information, the situation was different upon arrival. It became clear that work remained before the system would properly function. Specifically, the intake structure, where water enters the system, had clogged with leaves and debris, which decreased water flow to zero. Transportation of the system’s water from holding tanks to community homes required tap stands (small pipes with spouts that dispensed water). Although the system’s pipe framework was complete, the water was inaccessible to members because tap stands did not yet exist. Therefore, they continued to rely on previously used methods of water collection, including rain harvesting and collecting from rivers.

We learned that the Water Committee struggled with free-riders, individuals who benefited from the water system without contributing sufficient work hours, and lacked legal authority to operate the system and enforce regulations. A new perspective and understanding of the project in the context of this community helped our team designate the following goals: create an intake structure that would not clog, help the community finish the water line and install tap stands, construct a sedimentation tank, and engage in a reforestation effort.

Throughout the project, Saboe and engineers at REDDOM were important technical consultants in the construction and design of the intake structure and sedimentation tank engineering projects. We consulted the Water Committee daily to organize project goals, materials, and brigades of 10-15 community members to complete construction.

**Water Flow and Distribution**

*Intake Structure*

The flow rate, (rate at which water travels through the system, L/s), determined the amount of usable water in the system. The intake built in 2013 consisted of a check valve, a metal screen attached to the end of a galvanized pipe that prevented sediment from entering the system. In response to decreased flow rate due to build up of debris, we excavated the structure and utilized a design engineered by REDDOM and Daniel Saboe that would increase the amount of water entering the pipes and minimize the need for maintenance.
Tap Stand Construction

After completing the mainline, water flow improved and the Water Committee independently installed a public stand in each community, allowing members access to water. After this installation, the community began work on individual stands in the yard of each participating family. Our team and REDDOM provided the community with the materials to complete this installment, though their construction began after the team left.

Water Quality

Efforts to improve water quality included a sedimentation tank, reforestation above the source, and a chlorination system, each in response to water quality tests. Water tests detected positives and negatives for pH, hardness, heavy metal content, pesticides, lead, and chlorine. However, REDDOM conducted more advanced tests that showed presence of ten times the normal amount of fecal coliforms, tested positive for disease-causing pathogens, such as E. coli, and provided data that reinforced our water test results. Our team analyzed these water quality statistics and developed a project to target a potential source of contamination: cattle fecal matter deposits upstream.

Sedimentation Tank

Water carries pollution in the form of dirt, sand, and other particulates. To prevent debris from entering the system, the sedimentation tank aimed to decrease particulate concentration. Altitude data points were acquired using a surveying telescope to determine optimal sites for the tank. Criteria from Saboe specified that the tank had to be lower in altitude than the intake structure, yet higher than the first deposit.
tank, a tank that held water for future distribution. Since the intake and the deposit tank had a narrow elevation difference, the sedimentation tank needed to be at an altitude of 1 meter below the intake structure. The water level of the tank was also one meter, meaning the base of the tank lies 2 meters below the intake structure.

The sedimentation tank serves to decrease water flow rate and allow particulates to settle instead of entering the system. The incoming flow rate is 1.5L/sec, necessitating the reduction of turbulence to allow particulates to settle under uniform flow dynamics. This was achieved by redirecting flow evenly through a T-shaped structure with several punctured openings. Another consideration was to allow flow to stay in the tank long enough for particulates to settle. Possible particulates present in the water were clay, fine silt and sand. We used the slowest settling velocity—0.154cm/min for 0.01mm diameter clay—to determine the appropriate detention time: minimum 60 minutes. Using this time, the capacity of the tank was calculated by multiplying it by a flow rate of 1.5L/sec, the highest flow rate during rainy season. Assigning a 4:1 width:length ratio of the water path, the final design of the sedimentation tank is shown in the figure below.

To construct the tank, we relied on the expertise of local mason, Ramirez, who built a similar tank in Saboe’s community. After leveling the terrain, we constructed the tank using cinder blocks and iron bar. A galvanized 4” pipe directs flow into the tank and reduces strain from the weight of the cement and water pressure and decreases leakage. The final step consisted of building a top comprised of cement, fine silt, limestone dust, and a trap door for maintenance purposes.

Due to hilly terrain around the sedimentation tank and lack of a control, measurements of accurate turbidity changes were unrealistic. However, a JPC team returning to the community this summer will assess the success of the tank through various parameters.

**Reforestation**

Reforestation minimizes soil erosion, reduces sedimentation concentration, and filters various water pollutants (Calder). Cattle grazed in a field directly above the intake structure and due to the absence of trees, rainwater is not absorbed by the soil, but instead flows downhill, polluting the water with cattle feces. Research associates
fecal matter from livestock with pathogens such as *E. coli* and *Salmonella*, in addition to various parasites and viruses, clarifying the importance of addressing this contamination source to improve overall water quality (EPA).

Prior to planting trees we spent time contacting the owners of the land to gain their approval for the reforestation efforts. Enda-Dominicana, a local NGO, donated over 800 indigenous trees, which we planted in two weeks. All planted trees were of fruit-bearing species to prevent the use of trees for construction wood.

**Chlorination System**

Prior to departure, the Dominican government installed a chlorination system to combat the risk of *E. coli* and pathogens in the water supply. The returning JPC plans to assess this tablet fed chlorinator that is made of PVC for durability and easy installation.

**Results**

Our primary role was to facilitate efforts to increase water going into the system. Redesigning the intake structure, completing the distribution line and installing tap stands, and improving water quality through a sedimentation tank, chlorination system, and reforestation effort achieved this. By the conclusion of our project, we helped the community achieve this and more through the relationships, knowledge, and cultural experiences we gained and shared.

Flow rate measurements indicate that the quantity of water entering the system increased after reconstruction of the intake structure. With the new design, the system’s flow rate increased from nearly 0 L/min to 90 L/min in the rainy season and 54-60 L/min in the dry season. These flow rates enabled the reliable delivery of water to all seven public tap stands.

The sedimentation tank, which settled suspended solids to reduce the turbidity level, and the chlorinator worked to eliminate *E. coli*, while reforestation involving mango, almond, and cashew trees above the water source decreased runoff pollution.

We also achieved unexpected yet relevant results. With REDDOM’s aid, we directed the Committee to government officials that would work on formalizing El Corozo’s operational and sanctioning power over the aqueduct. We also helped to fund an additional 15,000L deposit tank to deliver water to 50 more families. Lastly, we provided materials for a barbed wire fence meant to keep livestock away from the intake structure.
Discussion

Sustainability

The community of El Corozo exists in an economic network that disincentivizes funding and organizational capacity building for the Water Committee. As a supplier of cocoa for the chocolate industry, El Corozo receives monetary aid from a multinational corporation, Mondelez International, seeking to reduce migration of El Corozo’s cocoa-bean producers to cities (Berlan & Berges, 2013, Goodyear, 2012). In the long run however, the system depends on the Committee’s capacity to collect and allocate sufficient funds internally.

Moreover, the Committee has yet to complete the national requirements to legally function as the managing body of the water system, and needs professional legal assistance for this. The Dominican model for water governance requires the Committee to register as a rural association of water users (ASOCARs) before INAPA (National Institute of Potable Water and Sewage Systems). The latter then provides technical training and sanitary supervision, while granting legal authority to the Committee to manage internal affairs.

Inclusivity: Gender and Race Dynamics

Teenage and middle-aged women and young boys bore the responsibility of water collection in El Corozo before the water system. Depending on household income, up to 5 hours a week were spent fetching water for cooking, laundry, cleaning and drinking. Although no literature proves a causal relationship between improved water infrastructure and higher participation of women in market-based activities (WB, 2010), we observed the enabling impact of potable water availability on Dominican women who sought to re-allocate their time to running a business of cocoa-based products. Thus, the aqueduct bears the potential to eliminate one constraint facing women’s labor supply. Yet, we acknowledge our project’s potential for racialized outcomes that reflect national racial disparities (MRGI, 2003). The Committee and work brigades contained few Haitians, making it unclear whether these tensions structured the opportunity for El Corozo’s Haitian immigrants to benefit from the aqueduct.

The Ultimate Results

Though successful, our project was not error free. Our original intake structure design included geotextile, a porous fabric intended to block all sediment while allowing water to pass through. Although engineers at REDDOM advised our team to use this fabric, it ultimately caused severe clogging and had to be removed.

When deciding where to build the sedimentation tank, we made errors in choosing a location to build, which led to unnecessary work and environmental damage. Our mistakes reflect our community partner’s initial hesitation to correct our misun-
understandings and our personal unfamiliarity in applying technical concepts to local conditions. Above all, they speak to the importance of owning up to the sizeable responsibility granted upon facilitators of development work.

It is easy and necessary to quantify a project’s success by number of goals achieved, but this fails to acknowledge the best and most important successes. Our friends in El Corozo now get to live more comfortably and safely in the place where they feel at home; and we are able to gratuitously reflect on the relationships we formed with welcoming and knowledgeable people.

Biographies

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Acknowledgments

We would like to thank our friends and partners in El Corozo’s Water Committee and work brigades, our generous hosts in La Rotonda, REDDOM, and the welcoming community of El Corozo in general. We are grateful for the essential collaboration of Daniel Saboe, and for the support of our advisors.
Recognizing the need for increased parent involvement in youth mentoring programs, the It Takes a Village team partnered with the Young Women Leaders Program (YWLP) in Charlotte to explore ways in which parents can engage and improve their relationships with their daughters. Through a variety of outreach methods, including the distribution of a parent handbook and focus groups, this project sought to improve parent involvement in and satisfaction with YWLP. The project was founded on the idea that “It takes a village” to help a girl through adolescence, which requires the collaboration of all the adults in her life. The two major goals of this study were to (1) explore and record the effectiveness of various methods of engaging parents in YWLP and (2) develop a foundation for mentor-parent collaboration. Our results suggested that both parents and mentors see the importance of mentor-parent engagement and believed a parent handbook would be helpful; however there are also limitations in scheduling and parent outreach that add difficulty to achieving this goal.

Introduction

Adolescent girls face a variety of obstacles that can get in the way of them leading healthy and happy lives. Girls can face body-image issues, conflicts involving dating and sex, and even depression. One buffer against these obstacles is parental involvement, which is tied to healthier childhood development. However, work and other commitments may make it challenging for parents to be involved as much as their daughters may need.

Mentoring programs, in which unrelated adults provide time and support to youth, offer a promising way for parents to supplement their own involvement and care. Youth that meet regularly with mentors are less likely to start drinking or start using illegal drugs, are more likely to stay in school, and can have increased self-esteem from the relationship. After enrolling their children, however, parent partic-

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ipation in the program can be minimal. Mentoring programs often fail to explicitly encourage parent participation, which prevents the programs from harnessing the potential benefits of mentor-parent collaboration. Research suggests that program engagement with parents can facilitate positive youth outcomes, including improved parent-youth relationships, but more research is needed to determine exactly how parents should participate to be most effective, as well as how to encourage this participation.

We worked with the Young Women Leaders Program (YWLP) at the University of Virginia. The program matches at-risk adolescent girls with female undergraduates who serve as mentors. Through a structured curriculum in weekly group meetings, the participants are encouraged to develop autonomy and self-confidence.

This project aimed to increase mentor-parent collaboration in YWLP through the publication of a parent handbook and increased outreach to parents for feedback, including a focus group. We had two major goals for this project: (1) to explore and record the effectiveness of various methods of engaging parents in YWLP, and (2) to develop a foundation for mentor-parent collaboration.

**Methodology**

*Phase 1 – Developing the Parent Handbook, Summer 2014*

Over the course of the summer of 2014, our team reviewed and updated a parent handbook for the parents of seventh grade girls participating in YWLP during the 2014-2015 school year. Our revision goals for the handbook were threefold: we sought to effectively communicate the important lessons from the YWLP curriculum to parents, to provide guidance and support for raising an adolescent girl, and to encourage parent participation in the program by including activities to do with their daughters that built on the mentoring curriculum. Among the information included in the handbook are tips for parents on encouraging healthy behaviors in their daughters such as stress relief techniques and icebreakers for discussions concerning body image. In order to achieve these goals, we analyzed and compared the current seventh grade YWLP curriculum to an older version of the parent handbook in order to identify discrepancies between the two. From our personal experience as mentors in the program, we felt it was appropriate to simplify the research for parents, emphasize curriculum content that is pertinent to parent-daughter relationships, and provide

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parents with action items supported by research for easy implementation at home. We then incorporated the updated material into a new parent handbook designed to facilitate parents’ navigation through the lessons. We hired a Spanish translator to translate the new parent handbook in order to ensure accessibility to several Spanish speaking families in YWLP.

**Phase 2 – Distributing the Parents Handbooks and Mentor Surveys, Fall 2014**

In September 2014, the English and Spanish versions of the revised parent handbooks were distributed to each of the four seventh grade YWLP groups. Of the four groups, 21 mentees participating in YWLP received a parent handbook. Later in the fall semester, we administered an online survey, via Qualtrics, to the 27 mentors who had participated in YWLP during the previous year in order to evaluate the quality of the relationship between the mentors, the mentees, and the mentee’s parents. Through quantitative and qualitative analysis, the surveys provided valuable insight on the factors contributing to successful mentor relationship. Additionally, the surveys evaluated parent engagement from the mentor’s point of view. During the fall semester, our team spoke with the YWLP mentor class to discuss the goals of our JPC project and to encourage the mentors to send us parent feedback concerning their experiences with YWLP as well as their thoughts on the revised handbook.

A second survey will be administered at the end of the spring semester in 2015 in order to evaluate the effectiveness of the handbook and its impact on parent engagement over the course of the project. The survey will help us evaluate whether our efforts had a positive impact on parent-mentor relationships.

**Phase 3 – Fall Finale Parent Focus Group and Parent Surveys, Winter 2014**

In December of 2014, our team held a focus group with parents who attended YWLP’s Fall Finale. Fall Finale consists of all participating YWLP groups coming together to celebrate the end of the semester. Parents who participated in the focus group were entered into a raffle for prizes that offered opportunities to spend time with their daughters.

During the focus group, we asked the parents to reflect on their experiences with YWLP as well as to address any concerns they had with their daughter’s involvement in the program. The parents answered questions regarding the effectiveness of the updated parent handbook (e.g., “Have you found the parent handbook useful
over the course of the semester?”) as well as questions related to their relationship with their daughter’s mentor (e.g., “What challenges have you faced in forming a relationship with your daughter’s mentor?”). The parents provided helpful feedback on the effectiveness of the updated parent handbook as well as the status of their relationship with their daughter’s mentor and what could be done to improve the program. Following the focus group, parents completed an anonymous paper survey that helped to further analyze the factors contributing to successful parent-mentor relationships and increased parent involvement in YWLP.

Results

Findings from the present study demonstrated a lack of parent engagement in YWLP, despite the fact that both parents and mentors saw engagement in the program as desirable. A total of 15 parents or guardians and 16 mentors were surveyed. Nearly 86% of parents surveyed indicated that a good relationship with their daughter’s mentor was “very important.” The 94% of mentors surveyed indicated that a good relationship with mentees’ parents or guardians was either “important” or “very important.” When parents and mentors were asked about their relationships with each other, however, the results were mixed.

Some parents were very satisfied with their relationship with their daughter’s mentor. Just under half of the parents surveyed indicated that there were “no barriers” to forming a good relationship with mentors. One parent described their relationship with their daughter’s mentor as “open and candid.” Most parents, however, indicated that there was at least one barrier in forming a good relationship with their daughter’s mentor. The most common barrier to better communication was the lack of time on the part of the parents, usually due to work or family commitments. For example, one parent indicated that they had not “had opportunity to spend time with her for personal reasons.” The findings in the mentor survey reflected similar issues; 50% of mentors reported feeling as though parents were often too busy to communicate with them regularly. Only one cited a language barrier, and three cited issues involving transportation--sometimes the families lived too far for home visits.
Prior to the creation of the parent handbook, most mentors believed that it would be helpful in informing parents about the program; 75% of mentors felt that parents were not very well informed about YWLP. When asked about the handbook in a focus group, parents conveyed that it was helpful: one parent stated, “I find [the parent handbook] to be a useful tool, especially the suggested questions and discussion to have with our daughters. I definitely think it should be kept in the program.” Others felt that there should have been more discussion about its usage either in a parent orientation at the beginning of the program, or at the beginning of the book itself. There were no results from the Spanish speaking parents due to lack of participation in the focus groups.

In terms of possibilities for improvements to the program, many parents felt that they would have benefited from a chance to meet the program directors and mentors, and to learn about YWLP at the beginning. They suggested that this meeting occur at their daughters’ Back-to-School Nights in order to “get the communication started early,” as one parent wrote, between them and their daughters’ mentors.

**Discussion**

This project aimed to increase collaboration between mentors and parents on their daughters’ growth in the YWLP curriculum. By creating a parent handbook and reaching out for more parent feedback, this initiative provided more opportunities for parent engagement.
Our results suggest that there is a need for increased outreach to parents and improved parent-mentor relationships in the YWLP mentoring curriculum. Parents and mentors alike generally agreed that the parent/mentor relationship was important. While both parties agreed on this, our results suggested a discrepancy: while mentors felt that parents were insufficiently involved in YWLP, parents seemed to feel content with their level of involvement with their daughters’ mentors. This could be a result of different expectations between parents and mentors, a lack of information of what it means to be involved as a parent in YWLP, and/or communication problems between both parties.

Findings on the efficacy of the parent handbook suggested that both parents and mentors believed that the creation of a parent handbook was generally helpful for engaging parents in the YWLP curriculum. However, some parents felt that the handbook would have been more useful had it been paired with a more comprehensive introduction to the program and the mentors. Overall, these results are a promising starting point for increasing parent and mentor engagement.

These findings should be considered within the context of some significant limitations to this study. Our parent focus group conveyed relatively positive feelings towards the program and their daughters’ mentors, however, this is limited by the fact that generally, the parents who attend focus groups and parent workshops are those who are more engaged in their daughters’ activities. Our research method excluded parents who were not able to make it to the program, whether that was because of other commitments or simply a lack of engagement. Another significant limitation was that due to scheduling complications, we were not able to interview or do focus groups with the 2013-2014 class of mentors and parents. As a result, we were unable to compare the attitudes and beliefs of parents who had the new handbook to those of parents who participated in YWLP without the handbook, and our results are thus purely descriptive. Future research may investigate further by comparing parents who used the handbook to parents who participated without it.

This initiative would benefit from parent outreach outside of the end-of-semester focus group. Future efforts may include increased programming for parents, such as a “Back to School Night” for YWLP parents, program directors, and mentors. While our findings did not include much information on how to reach out to Spanish-speaking parents, our experiences lead us to conclude that better outreach is still necessary.
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Biographies

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Implementing and Evaluating a Sustainable Early Child Development Program in Limpopo, South Africa: A Pilot Study

Gwyneth Milbrath, Vidya Gopinath, Claire Constance, Audrey Ogendi, Madison Compton, James Plews-Ogan, MD

Inadequate stimulation affects 20-25% of children in the developing world; however, providing increased stimulation to young children can improve cognitive and social-emotional competence. The purpose of this study was to determine the suitability and feasibility of an early child development (ECD) assessment tool and program to improve ECD in Limpopo, South Africa. This sample consisted of 18 South African primary health nurses. Focus groups were conducted to select an appropriate assessment tool. An educational intervention was used to teach nurses about ECD. Knowledge surveys and focus groups were used to evaluate the intervention. The Ages and Stages (ASQ) program was most feasible for this population. Knowledge of ECD significantly improved after the educational intervention (p<0.001). Nurses believed that ECD monitoring and interventions are needed to improve child health; however, several barriers to implementation were identified. Overall, a child development monitoring program is feasible in this community. Limitations include time, cultural barriers, and a small, non-generalizable sample. Future research includes assessing children using ASQ and increasing the area of screening and participation.

Introduction

More than 200 million children under the age of 5 fail to reach their cognitive potential due to poverty, poor health, poor nutrition and lack of care (Grantham-McGregor et al., 2007). According to the World Health Organization, inadequate cognitive stimulation affects 20-25% of children in the developing world, resulting in an estimated 20% loss in adult productivity (2003). However, consistent evidence from early child development (ECD) literature states that interventions providing increased cognitive stimulation or learning opportunities for young children significantly increase cognitive and social-emotional competence throughout life (Walker et al., 2007). A nurturing environment with adequate stimulation, care, and social interaction is critical to optimizing cognitive development. Early intervention has been shown to improve outcomes for infants at risk for growth and developmental problems (de Souza, Sardessai, Joshi, Joshi, & Hughes, 2006).

The purpose of this study is to compare the acceptability and feasibility of two pediatric assessment tools to track child development in a rural health district in Limpopo, South Africa. The two tools selected are Ages and Stages Questionnaire (ASQ) and The Cognitive Adaptive Test/Clinical Linguistic and Auditory Milestone Scale (CAT/CLAMS). Currently, in this community, public health nurses are not formally
educated on the importance of child development in their training, nor is there any monitoring, intervention, or referral program in place for children who are developmentally delayed. A sustainable child development program in this community could ultimately decrease the incidence of pediatric injury and improve child mortality, literacy, and school graduation rates. The goals of the pilot study are the following:

- Determine the usability and feasibility of a child developmental assessment tool in Limpopo, South Africa
- Discuss and select a child developmental tool to be used in the local clinics
- Assess the local public health nurses’ knowledge and perception of child development
- Determine the barriers to implementing a child development project in this community
- Train public health nurses on child development, and teach practical interventions that can increase stimulation and engagement of young children

**Ages and Stages**

Ages and Stages Questionnaire (ASQ) is a screening tool used to identify children aged 2 – 66 months who may be at risk for developmental delay (Squires, Bricker, & Potter, 1997). The survey assesses five domains of development: (1) gross motor, (2) fine motor, (3) communication, (4) problem-solving, and (5) personal-social.

The surveys require caregivers to report their child’s ability. The test is graded and compared to a screening cutoff score, which was standardized on a stratified sample of 2,008 US children. It has additionally been used in low-income international populations, with best results in Latin America, but has not been tested in South Africa (Kyerematen, Hamb, Oberhelman, Cabrera, Bernabe-Ortiz & Berry 2014). In previous ASQ validation studies, the ability to identify children with delay varied from 51%-90%, with an overall sensitivity of 75% and specificity ranging from 81% to 92% (Rydz, Shevell, Majnemer, & Oskoui, 2005).

**CAT/CLAMS**

The Cognitive Adaptive Test/Clinical Linguistic and Auditory Milestone Scale (CAT/CLAMS) was developed to discover global cognitive delay and language delay by evaluating language (CLAMS) and problem-solving skills (CAT) independently in children up to 36 months old (Wachel, Shapiro, Palmer, Allen, & Capute, 1994). This assessment tool uses instruments (toys) to assess development through direct observation. The use of CAT/CLAMS was originally established in populations of children thought to be either delayed or at risk of delay, but has recently been used to screen general populations (Leppert, Shank, Shapiro, & Capute, 1998; Pittock, Juhn, Adegbenro, & Voigt, 2002; Wang, Wang, & Huang, 2005). The test items are designed to build on
each other to allow a more natural advancement for the child until the child is no longer able to complete a task (Leppert et al., 1998).

**Research Setting**

The research was conducted in the Vhembe Health District of Limpopo, South Africa. This district is located in the northernmost region of Limpopo, and is one of five districts in the region. In 2011, the district had a population of almost 1.3 million people, of which 93% were dependent on public health care, and a 38.7% unemployment rate (Statistics South Africa, 2012; The South African Health News Service, 2013). The main languages spoken in the Vhembe health district are Tshivenda (69%) and Xitsonga (27%) (The South African Health News Service, 2013). This district is primarily rural with small villages scattered throughout the countryside and includes the small city of Thohoyandou. The health district consists of 112 clinics, 8 community health centers, and 6 public hospitals (The South African Health News Service, 2013).

**Methodology**

*Participants*

Participants were recruited in the Vhembe Health District of Limpopo, South Africa. Nurses were chosen to participate because they are the primary health providers within the community, and would be responsible for using the assessment tool to identify at-risk children. In order to be eligible for the study, nurses had to be proficient in English writing and conversation, and work within the Vhembe health district. Refreshments were provided during the study sessions, and participants received no compensation for their participation. The questions that were asked in each focus group can be found in Table 1.

**Table 1: Focus Group Questions**

<table>
<thead>
<tr>
<th>Assessment Tool Focus Group Questions</th>
<th>Posttesttraining Focus Group Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>What did you like about the assessment tool?</td>
<td>What did you like or dislike about the program?</td>
</tr>
<tr>
<td>What was difficult or challenging about the assessment tool?</td>
<td>What did you think of the presenters?</td>
</tr>
<tr>
<td>How confident do you feel using the assessment tool on a child in your clinic?</td>
<td>What did you think about the topics presented?</td>
</tr>
<tr>
<td>How do you see this assessment tool fitting into your work with young children in the clinics?</td>
<td>How will this program change your practice?</td>
</tr>
<tr>
<td></td>
<td>How could the training session be improved?</td>
</tr>
</tbody>
</table>
Assessment Tool Focus Groups

Two focus groups were conducted using a semi-structured approach with the same questions and content presented to each group. The focus groups consisted of 5-6 nurses that were randomly assigned into one of the two focus groups as well as a moderator, co-moderator, and observer. Each group learned and discussed both ASQ and CAT/CLAMS. Qualitative analysis using versus coding was used to compare ASQ versus CAT/CLAMS and Group 1 versus Group 2. The time for each focus group was 20 minutes for instruction and 30 minutes for discussion of each tool.

Child Development Training Session

A day-long educational intervention on ECD was taught to 18 nurses. Immediately prior to the training session, the nurses were asked to complete a 17-item baseline knowledge pretest related to ECD. The curriculum included lectures on the importance of ECD, major domains of childhood development, and ECD interventions to be taught to parents/caregivers. A similar posttest with 20 items was administered at the completion of the training, including 4 questions to assess comprehension of the developmental assessment tool. Each question was categorized by level of difficulty and question content which is found in Table 2. Both the pretests and posttests from the child development training session were graded twice by two individuals.

Table 2: Number of questions asked in pretest and posttest by content area and difficulty level

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Area of Development</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Significance of Child Development</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Nursing Action</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Injury Prevention</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Developmental Interventions</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Developmental Milestones</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Assessment Tool</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td><strong>Level of Difficulty</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1 (identification, definition)</td>
<td>8</td>
<td>11*</td>
</tr>
<tr>
<td>Level 2 (ordinal, matching)</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Level 3 (application)</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

*This includes seven questions similar to the questions in the pretest as well as four questions specifically evaluating the assessment tool.
The pretest and posttests were matched by individual to allow for paired comparisons. Data were analyzed using Microsoft Excel and SPSS v 21. Descriptive statistics were used to calculate mean score and standard deviation on the pretest and posttest. Data was normally distributed. Paired t-test was used to measure differences between pretest and posttest scores. Item analysis was completed using chi-squared tests to determine differences between pretest and posttest performance in each item category, with a level of significance of less than or equal to 0.05.

Posttest Training Focus Group
The final two focus groups were held concurrently three days after the training session was completed. The groups consisted of 3-4 nurses each and discussed the training’s content, presentation, and applicability to practice. Relevant follow-up questions were asked by the moderator and co-moderator while the observer took field notes. The total time for the discussion was between 30-45 minutes.

Results
Assessment Tool Focus Groups
Quotes relevant to the research question were identified from the transcripts of the two focus groups, and were coded into 16 uniquely defined codes. The strengths and weakness of each tool identified by the nurses in the focus group was summarized by categories. Overall, nurses supported the use of Ages and Stages in their community over CAT/CLAMS.

The nurses first described their current practice and experiences related to child development in the clinics. According to the nurses there is no local system to routinely screen children for developmental delay, and eventually to the hospital for further testing. Despite health education provided to mothers when they give birth, the nurses perceive a large child health knowledge deficit and a general indifference toward health education. In this culture, parents will delay seeking formal care, and ask neighbors and elders for advice or herbal remedies prior to seeking care at a clinic. In some cases, the nurse reports by the time the child arrives in the clinic, he or she requires advanced care, and must be transported to a hospital.

After learning about the tools, the nurses discussed new knowledge and the importance of child development within their community. With both the ASQ and CAT/CLAMS tool, nurses are able to have a more meaningful interaction with parents and children. The nurses believed that the tools would improve the overall health of children in the community through improved disease surveillance. The nurses would pass forward this new knowledge to parents and community members and teach parents the importance of play, meaningful ways they can play with their children, and the importance of child development to the long term health of their child.
**Child Development Training Session**

During individual item analysis, there were no significant differences. Scores improved significantly after the training compared to pretest scores ($p < 0.001$). The mean score on the pretest was 49% ($\pm 14\%$) and the mean score on the posttest was 75% ($\pm 12\%$). The posttest had 4 questions on the ASQ; the mean score excluding questions about the assessment tool was also 75% ($\pm 12\%$). As shown in Table 3, significant improvements between pretest and posttest results were seen in the majority of the questions categorized by both difficulty and content area except in nursing application and milestone achievement markers. All nurses answered the nursing application questions correctly in both the pretest and posttests, so scores could not be improved. The lack of improvement in milestone achievement markers may be due to the necessity of memorization of this information and inadequate time to retain this information during the short training session.

**Table 3: Individual Item Analysis of pretest and posttest scores by question difficulty level and by content area**

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Posttest</th>
<th>Difference</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average grade</strong></td>
<td>49%</td>
<td>75%</td>
<td>26%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td><strong>Level of Difficulty</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td>50%</td>
<td>82%</td>
<td>32%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Level 2</td>
<td>44%</td>
<td>56%</td>
<td>13%</td>
<td>0.014*</td>
</tr>
<tr>
<td>Level 3</td>
<td>50%</td>
<td>87%</td>
<td>37%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td><strong>Content Areas</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core Area of Development</td>
<td>36%</td>
<td>73%</td>
<td>37%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Significance of ECD</td>
<td>52%</td>
<td>94%</td>
<td>42%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Nursing Action</td>
<td>100%</td>
<td>100%</td>
<td>0%</td>
<td>1</td>
</tr>
<tr>
<td>Injury Prevention</td>
<td>33%</td>
<td>89%</td>
<td>56%</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Milestone Achievement Markers</td>
<td>59%</td>
<td>61%</td>
<td>2%</td>
<td>0.92</td>
</tr>
<tr>
<td>Interventions</td>
<td>44%</td>
<td>61%</td>
<td>17%</td>
<td>0.002*</td>
</tr>
</tbody>
</table>

*p-values are significant at $p<0.05$.

**Posttest Training Focus Group**

Nurses were positive about the education session, and reported meeting all of the learning objectives, that the session contained important content, and it was understandable despite language and cultural barriers. Nurses enjoyed using activities and personal experience over lectures to learn and retain important material. Suggestion modifications for future trainings include incorporating breastfeeding into the
training, training a wider variety of nurses, integrating training into current health promotion strategies, and a quick guide resource pamphlet to use during patient interactions. Nurses expressed concerns about having time to train other nurses, and suggested integrating the trainings into current nursing curriculum to decrease the time burden and increase the number of nurses being trained.

Discussion

The Ages and Stages (ASQ) tool was identified as most appropriate for this setting because it is more time efficient, and is less expensive than the CAT/CLAMS tool.

As alluded to in our results section, significant improvements between pretest and posttest results were seen in the majority of the questions categorized by both difficulty and content area, supporting the effectiveness of the educational training. Our findings show that a child development monitoring program is feasible in this community.

Limitations included time, cultural barriers, and a small, non-generalizable sample. However, the data found in this study is validated by other similar studies of diverse populations (Birbili & Tzioga, 2014; de Souza et al., 2006; Rydz et al., 2005; Toran, 2007). The next phase of the research would be to train and evaluate the knowledge of the nurses about child development and the Ages and Stages screening tool, and culturally adapting and validating the tool for this population. Additionally we would want to look at assessing children using ASQ and increasing the area of screening and participation. Training community health workers to use the Ages and Stages tool and creating a quick reference pamphlet are also identified as future areas of program expansion.

References


Initiative reCOVER: School for Pantanal, Granada, Nicaragua

Aaron Bridgers, William Haynes, Rachel Himes, Alexandra Iaccarino, and Nicole Zaccack
Faculty Advisor: Anselmo Canfora

Initiative reCOVER is a University of Virginia, School of Architecture collaborative design-build research project. Founded in 2007, it aims to form productive collaborations with community-based organizations to facilitate the design and construction of safe and sustainable buildings around the world. During the fall of 2013, reCOVER partnered with the Granada Christian Education Center to design a primary school and master plan on a site south of Granada, Nicaragua. The overall scope of the project includes building educational facilities for approximately 800 children in the community of Pantanal that implement improved sustainable building practices.

Introduction

In the last decade, enrollment increased in primary education in Nicaragua by twenty percent; yet in spite of this progress, only forty-four percent of the children who begin primary school reach the sixth grade. As the lowest figure in Latin America, local communities and nongovernmental organizations (NGO’s) partnered in efforts to help achieve a UNESCO’s 2015 Education for All Goal to ensure that “all children have access to, and complete, free and compulsory primary education of good quality.”

To address this challenge, Initiative reCOVER partnered with the Granada Christian Education Center (GCEC), a non-profit organization based in the region of Granada, which upholds education as a priority in transforming a community’s well-being. GCEC serves a prominent role in the city of Granada through outreach programs. For example, The Bridge, brought the first Young Life and City Dump Ministry to the community, as well as additional projects offering training and employment to the youth and single mothers of Granada’s poorest neighborhoods. Their current efforts extend to Pantanal, a marginalized community located on the outskirts of Granada. GCEC recognizes the importance of community-based assets and seeks to implement facilities to support economic development through educational, vocational, and spiritual opportunities for future generations of Pantanal.

With these goals in mind, the reCOVER team worked in close collaboration with GCEC and members of the community to identify Pantanal’s needs for educational

1 “Nicaragua Census 2010.” UNICEF.
2 “Nicaragua Census 2010.” UNICEF.
3 “Education for All Goals.” UNESCO.
facilities. The community is home to over 800 children with little to no access to education.\textsuperscript{4} Minimal instruction is available, as current enrollment rates for secondary education in Nicaragua rest at thirty-five percent for males and forty-seven percent for females.\textsuperscript{5} Additionally, many Nicaraguan families cannot afford to send all of their children to school and consequently, approximately 300,000 children out of 2.8 million in Nicaragua are found working instead of attending school.\textsuperscript{6} Despite this scarcity of resources, the Pantanal community thrives through self-initiated vocational trades, indigenous arts and craft production, and small-scale agriculture. In partnership with GCEC, the project's objective is to create a well-integrated and well-crafted primary school building that provides access to quality education in Pantanal.

Beginning the spring of 2014 in a seminar taught by Professor Canfora, the reCOV-ER team focused on the analysis and understanding of climatic and weather variations, local construction practices, and socio-cultural frameworks, which ultimately led to a set of preliminary iterations of the school design before the team conducted an official site visit the summer of 2014. The final design takes into account GCEC's vision and employs sustainable design strategies. The improvement of local building practices to provide safe learning environments was a primary focus of the team's work and informed improvements in building craft, passive environmental systems, and diverse instructional spaces for the Pantanal School.

\begin{enumerate}
\item \textsuperscript{4} "The Community of Pantanal". (2012, September 5). Granada Christian Education Center.
\item \textsuperscript{5} Rogers, Tim (2012, March 20). Impoverished teachers, poor schools.
\item \textsuperscript{6} "Nicaragua Census 2010." UNICEF.
\end{enumerate}

\textit{Primary school site plan}
Methods

Throughout the development of the project the design team acknowledged that the focus was on a singular classroom module that would ultimately be adjusted and replicated across the entire planned site. A method of design development required on- and off-site investigations and an iterative design process involving multiple versions of spatial, morphological, and tectonic studies, represented through drawings and three-dimensional models. We informed a series of design decisions by considering precedent studies, on-site topographical analyses, building practices of local contractors, pedagogical methods of teachers, and GCEC stakeholder suggestions. This process, informed by a design thinking methodology⁷, further involved the synthesis of priorities defined by GCEC, the team’s overall intention to improve on existing school models, and the availability of local resources. These factors, as well as feedback from our faculty advisor and structural engineering consultant, the Arup Cause, led to the final design iteration currently under construction.

Prior to travelling to Nicaragua, the team prepared a “field manual” during a spring semester seminar led by professor Canfora. The book included Nicaraguan historical and cultural information, climatic and seismic activity of the region, GCEC’s involvement in the region, and a working catalogue of common building practices in Granada. The team also carefully considered precedent studies of schools built in regions with similar conditions.

During the 25 day trip to Granada, Nicaragua and surrounding cities, our team developed a better understanding of the culture, the building site, and the current methods of construction that ultimately served as the foundation for many of our design decisions. Some of our most insightful meetings were with local educators that were directly involved with the construction of their schools. Our team prepared drawings and models for these meetings with the intention of gathering relevant feedback to the design process. Geralyn Sheehan of the Opportunity International School described to us how their strategy for phased-based construction allowed them to determine the optimal size, orientation, and placement of their classrooms. Eric Loftsgard and Nathan Boersema of the Nehemiah Christian Education Academy shared their experiences with local builders in Nicaragua by illustrating what materials or construction techniques had been successful or not during their school construction. Narlly Mendez from the Dario Christian Academy emphasized the importance of student safety through visibility and described some of the cultural challenges related

⁷ “Bootcamp Bootleg.” Hasso Plattner Institute of Design at Stanford. Design thinking methodology is defined by The Institute of Design at Stanford as “the combination of the process, skills, cognitive processes, and attitudes prevalent in design.” The team iteratively employed the five process modes of design thinking: empathize, define, ideate, prototype, and test.
to how parents queue around the school that could be effectively addressed by the architectural design.

A professional 50-acre site survey of the Pantanal School plot, helped inform a comprehensive site design, including a reliable mapping of areas of soil erosion, significant landscape features, vehicular and pedestrian circulation paths, and building locations. Time spent in the community of Pantanal led to critical observations about daily school routines, the effects of local economic conditions, and evidence of ways to apply sustainable community development. Frequent visits to brick manufactures, tile factories, metal fabricators, building supply distributors, markets, plant nurseries, and local vernacular architecture allowed our team to compile a comprehensive catalog of materials and vegetation that was consistently referenced throughout design development of the school.

Utilizing resources available at the School of Architecture, our team spent the balance of the summer developing drawings, three-dimensional models, and renderings of the school design. We met frequently with our faculty advisor per week and our community partner through conference calls, while consulted with Arup engineering when necessary. By the end of the summer, we were able to complete a “building reference set” for GCEC to use for pricing purposes. The construction timeline was delayed temporarily due to miscommunications about material specifications further clarifications of building details, but the team responded well to these request for additional information by producing supplementary documentation throughout the fall semester.
Outcomes/Results

The final site strategy aims to promote outdoor learning and takes into account climactic and weather patterns on the site in support of a series of outdoor classrooms. Seasonal winds from Lake Nicaragua to the east, the sun’s path throughout the course of the year, and heavy rains from October to December were important considerations during the design of the outdoor classrooms. These spaces are organized around circular “nodes” that serve as formal and informal meeting spaces, while also providing a separation between classrooms for noise reduction and safe egress requirements. Each node is defined by grade-level change, retaining walls, and seating. A fourth, node brings together a series of administrative offices.

The classroom design addresses climatic conditions through utilization of clerestory openings in the roof to allow for indirect natural light and ventilation to move throughout the space. Tall windows encourage cross ventilation from one side of the classroom to the other. Porches on the south side of the classrooms protect the interior from direct sunlight and driving seasonal rains. A secondary trellis system shades the facades.

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the common node space and functions as a transition between inside and outside.

In order to ensure a safe learning environment, security is also a primary consideration in the design. Curvilinear retaining walls demarcate the boundary for each node gathering space, while a large open lawn provides visibility from the central administrative building to each of the three outer nodes. The central lawn and outer edges of the plan integrate the surrounding landscape into the operation of the school and promote exploratory learning.

The first classroom constructed in early 2015 increases the community’s access to education with twenty-four students scheduled to enroll in the preschool program later this year. The JPC graduate mentor, Aaron Bridgers, traveled to Granada to facilitate construction processes and ensure that the design was effectively communicated to local builders. Observations and documentation of the construction were shared with Ewan Smith of the Arup Cause and Professor Canfora for review. This collaboration generated on-site recommendations, such as changes to brick-laying techniques, proper structural detailing of the steel reinforcement, and clarification of other details found in the design drawings. A series of minor, low-cost suggestions resulted in improvements in quality of construction and safer construction practices in the field.

While the drawings and details for the project are represented through conventional methods of architectural representation, it is important to note that the Nicaraguan construction industry bases their building practice largely on oral communication and hands-on knowledge passed down form generation to generation. Few builders have received professional training and find it challenging to understand architectural drawings. Through on-site construction meetings, followed by informal conversations over the span of the visit, Aaron Bridgers interacted with the construction crew to offer sugges-
tions about structural detailing and its importance to the structural integrity of the building. Subsequent progress was made as the builders incorporated recommendations and adjusted their own construction practices. This close collaboration between local builders, the community partner, the Arup Cause, and Initiative reCOVER contributed to an advancement of safer building practices in the community.

Discussion

Through close collaboration with our community partner and countless others, our team has helped facilitate the empowerment of Pantanal and the greater Granada community by providing additional access to education. By simultaneously respecting local building practices and establishing a model for a safe and structurally sound school design, the Pantanal School serves as a model for improvements in building techniques that will influence the construction of future schools in the area.

Challenges emerged throughout the project due to factors including: differences in building standards; communication between client, design team, and builders on site; construction costs; and an ambitious construction start date, although our team effectively addressed those challenges through open communication and active involvement on site by our partners Sarah and Charles Kaye and graduate mentor Aaron Bridgers. Aaron’s second visit in January 2015 was essential in maintaining an open and trustworthy dialogue with local builders to effectively communicate construction intentions for the school’s design.

After completing the first design and construction phase, our reCOVER team has developed a comfort and understanding for moving forward in addressing complex design problems that necessitate participation on behalf of all stakeholders to ensure a successful result. Post-occupancy studies of the first construction phase will provide feedback on the efficacy of the passive design strategies, classroom organization, and maintenance and life cycle of the building. As the design development and future construction continues for teacher housing, a secondary school, and trade school buildings, we will continue to apply skills sets and principles learned during the first phase to continue to improve our design process.

Integrating local traditional building methods and materials; directly involving community stakeholders and builders in the design process; and improving construction details and methods, the El Pantanal Primary School project underscores the need for well-designed and well-built educational facilities that play an important part of the future development of the community of El Pantanal.
References


Acknowledgments

Charles Kaye and Sarah Rife Kaye (GCEC), Bethany Burrows (GCEC), Ewan Smith (Arup), Matthew Hartley (Arup), Clare Wilding, David Edmunds, Baker Nicolaou (GCEC), Megan Suau (SARC-reCOVER), Eric Field(SARC), Carmen Trudell (SARC).

Biographies

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Culture Learning Through Community Engagement

Madeleine Brehaut, Katie Gronsky, Christina Leas, and Yutong Li
with advisor David Germano

Abstract

A multidisciplinary team of UVa students conducted research in Lhamo, a Tibetan town in China, to address the following question: How can cultural differences be recognized and addressed through the process of a multi-cultural collaboration on an environmentally based service-learning project? They helped design and build an addition to their community partner's eco-community center, which aimed to educate locals and tourists alike on the cultural and environmental changes the region faces due to global factors. The team reflected on various stages of the project through the lens of cultural learning. They then analyzed the relevance of particular cultural dynamics to the success of their project. Their goal is to show the significance of cultural learning in the success cross-cultural collaborations, in particular student service-learning projects.

Introduction

Participants in cross-cultural projects often fail to appreciate fully the cultural intricacies of their allies. Sometimes referred to as cultural competence or cultural intelligence, this process involves listening to and making sense of unfamiliar customs and values. The topic is increasingly important in all fields, both educational and professional, where individuals work internationally to harness diverse networks (Peterson). Collaboration across cultures is also essential for indigenous groups as globalization increases physical encroachment on indigenous territories, resulting in adverse effects on environment and livelihood (Smith), as well as on cultural traditions and community cohesiveness.

A multi-disciplinary team of UVa students explored the significance of cultural learning within the context of a Jefferson Public Citizen (JPC) project in Tibet. We addressed the question: How can cultural differences be recognized and addressed through the process of a multi-cultural collaboration on an environmentally-based service-learning project? We investigated the values, concerns, and daily practices of Tibetans in the town of Lhamo, China by contributing to the expansion of an eco-community center, which involved both construction and educational programming. Through collaboration and daily exposure to locals’ ways of life, we reconciled differences of cultures that ultimately contributed to the project’s success. Our goal is to encourage future undergraduate student researchers to consider cultural realities when designing and navigating projects, service-learning or otherwise.
Background

Lhamo is a small town located on the border of the Chinese provinces Sichuan and Gansu within Zoige County, part of the Amdo (southeast) cultural region of Tibet (New World Encyclopedia). It has an approximate population of 4,000 people, with a mixed demographic of Tibetan, Muslim, Hui and Han Chinese. Tibetans have occupied Lhamo for the majority of its history, making Tibetan Buddhism a primary influence on local cultural traditions (Delek).

Lhamo has experienced several recent changes and resulting challenges, largely due to globalizing forces. Sparked by Han Chinese expansion into western regions of China, and Western nations’ interest in Tibetan culture, Lhamo has grown in popularity as a tourist destination for Chinese and foreigners alike. This has contributed to an increase in non-biodegradable trash, which, without an appropriate disposal system, has led to pervasive littering. This has resulted in waterway pollution, air pollution from burning of trash, and injury or death to both wild and domestic animals that inadvertently eat trash (Turner). Increased tourism has also contributed to cultural changes, as locals interact with outsiders, change their lifestyles to take advantage of opportunities related to tourism, and even change demographically as more Han Chinese move to Lhamo (Li, Fischer). Additionally, because of changing land use and global climate change, the grasslands on which the nomads relay for yak herding are degrading at an alarming rate (Meinert).

This myriad of cultural and environmental issues inspired a local leader of Lhamo, Palzang, to create a space where the region’s culture and environment could be protected under Tibetans’ terms. He envisions the creation of an “eco-community center”, which will include a hostel and library where tourists are welcome to learn more about Tibetan culture and the local environment. Additionally, it would provide a space for collaboration between Tibetan communities and Chinese government officials on issues such as trash management and the desertification of grasslands.

To help him accomplish this vision, Palzang asked our team to build a kitchen out of recycled glass bottles and local construction materials. Adjacent to the hostel and library, the space would provide opportunity for community members and visitors to visually appreciate environmental issues regarding trash and its potential for alternative uses. It would also serve as a space for tourists to learn more about Tibetan culture in the form of cooking and cuisine.

Learning through Process: A Methodology

Our understanding of cross-cultural collaboration arose through a process of initial planning before arrival, adjusting expectations upon arrival due to cultural realities, and reflecting on the significance of the changes we made to our project. The reflection process, based on similar studies, has led to sense-making of culture among
the team (Easterby-Smith). Thus, the structure of this paper will focus on specific encounters and how they led to a retrospective cross-cultural understanding. Then, we elaborate on how these experiences helped us to better implement our project.

Community Roles

In America, we are used to engaging within a public space, where the majority of people’s relationships, especially on something as impersonal as a construction project, are based on professional ties. We were expecting to work in a similar environment coming to Lhamo, interacting with a variety of community members who had no direct investment in the project. In fact, many of the people we interacted with, from the architect to the construction store owner, were close friends of Palzang, and their willingness to participate in our endeavor was likely based on our relationship to him. Thus, pre-existing personal relationships became essential to the success of our project, as some community members effectively became extensions of our team. While perhaps we only engaged one of many networks of relationships in Lhamo, instead of the wider community, as had been our intention, we were able to receive help from people more personally invested in the project.

Leadership Roles

We initially believed we would completely direct and implement the project. However, we soon realized there were aspects of the project that we simply did not have the technical or cultural experience to navigate, and needed to be delegated to community members. This reality first became apparent when acquiring the wood used for our building’s frame. Only the carpenter was able to evaluate the quality of wood and negotiate effectively. While the JPC team led the design portion of the project, from this point on, due to our lack of building expertise, the carpenter directed the project’s implementation. This became apparent after we accidentally offended our carpenter by asking him too many questions about the wood’s quality. Questioning – normally a positive action in American culture - was interpreted by the Tibetan carpenter as untrusting of his expertise and offensive. For the remainder of the project, despite our uncertainties and concerns, we asked few questions and trusted the direction that he took in the project. This lesson was essential in future dealings with other local experts.

Gender Roles

The building process taught us about the gender dynamics of physical work in Tibetan society. Many Tibetan women perform physical labor regularly, capable of carrying heavy loads and making the traditional mud mixture used for construction. However, we rarely saw women work in more skill-based crafts, such as carpentry or bricklaying, and we never saw women directing building projects. Our JPC team, con-
sisting entirely of women, did not conform to these standards; none of us were used to heavy labor and we were the directors of the building’s design. We quickly learned that acceptance and appreciation from our Tibetan building crew, which consisted mostly of men, came from putting in physical effort. Additionally, while planning happened behind the scenes, we attempted to not direct the building processes too forcefully in order to avoid offending male construction workers.

*Ethnic relations*

One initial goal of the project was to engage both the Tibetan and Muslim communities, in an attempt at cross-cultural collaboration. This was not as successful as we hoped due to historically based tensions between the two ethnic groups. These were explained as originating with the Chinese encroachment into Lhamo, which led to financial support of Muslim endeavors at the expense of Tibetans. Since the connections we relied upon were Palzang’s family and friends, nearly all of our acquaintances were Tibetan. Less Muslim interest in our project may also have been due to anti-American sentiment, as experienced by team members who had visited Lhamo the year before. The only opportunities we had to introduce Muslims in our project was during bottle collection. When we were collecting bottles at hostels, owners and residents were intrigued by our project and occasionally agreed to help at the worksite.

*Community Engagement*

Initially, we hoped to attract volunteers and generate interest in our project via fliers posted around Lhamo. However, we soon learned this would be inappropriate given the tense political situation. Residents of Lhamo had protested against the Chinese Communist Party in the past, followed by a violent government response, so any form of organizing and public canvassing could be interpreted as threatening to government officials (Tolson). We eventually found, though, that advertisement spread easily by word of mouth, especially among the monastic community. The project seemed to spark the locals’ curiosity, and many were willing to help. After only a week of our arrival, many community members, especially monks, had already heard about the project and were curious to come and watch us clean bottles. Many offered support in the form of bottle donation or help with the decoration of the kitchen.

*Education and Research*

The second component of our project aimed to educate visitors and locals on environmental issues. We researched areas of concern our community partner had identified, including trash, its effects on the environment, and recycling. We planned on holding community events where we would present the information through discussion, lecture, and interactive activities - such as poster making and water testing. Our first event involved our Tibetan translator’s nomadic relatives. However, they were
unwilling to divulge much information to people younger than them. Upon realizing the ineffectiveness of the classroom style approach, we decided to create a book of the information we had planned to teach (both in English and Chinese) to be used as a feature of the future eco-community center. This way people could read and learn at their own convenience, then transmit the information to others verbally, so the information could potentially reach more people.

In an attempt to gain greater cultural understanding of environmental issues, the team also planned to conduct surveys and focus groups among locals. However, time demands and changes in the dynamic of our team led us to alternative ways of accessing this information. We decided a richer and more culturally relevant approach to our data collection would be through the form of story collection. Approaching various members of the community, we requested that they write or draw pictures to recount a traditional story, myth, or personal experience regarding the natural environment. Each submission reflected the interests, concerns, and knowledge of the local people. We collected these reflections into a book that will be on display at the future community center library, alongside the book on environmental education.

**Analysis**

In order to analyze the impact of cultural differences on our project’s implementation, the team utilized an evidence-based technique for reflecting on experiences in the field. First we shared stories that we felt impacted the outcome of our project while attempting to find underlying features of culture that seemed constant throughout the scenarios described above. The elements we identified included social norms, work ethics, religious ties, political tensions, and language barriers. Then, borrowing methods from previous cross-cultural studies, we coded the events based on a 1-10 scale to visualize the significance of each cultural element (Shadewitz). The more we perceived a specific cultural element impacted a scenario, the lower a rating it received on the scale.

For example, the social norm of gender roles (women perform physical
labor) was of high context to our project. On the other hand, social norms surrounding community engagement was of little context (i.e. did not impact our project’s implementation significantly relative to those in other scenarios). Of course, the values assigned to these scenarios were highly subjective. However, the process of discussing and comparing situations helped the team better process and understand the cultural factors at play in our project. Without this reflection, culture learning would not have been as thorough.

Conclusion

It will not be possible to know the real impact of the eco-community center until the kitchen is completed and the library and hostel are open to visitors. We hope the center provides an effective, sustainable resource for increased awareness and inspiration of community-led environmental restoration projects. By drawing upon information originating from the community, our final collection of materials, including educational information on environmental stewardship and local stories, provides an informative resource relevant to the culture and region.

However, we believe an equally significant impact of our project was widening understanding about culture learning through collaborative service-learning. Ultimately, without the ability to conduct thorough ethnographic research, we recognize that our understandings and interpretations of Tibetan culture are not complete. However, without our willingness to adapt and attempt to understand cultural factors relevant to our project, it would not have been as successful. We hope our insight can assist future student researchers reflect on the cultural forces that shape cross-cultural collaboration.

References


**Biographies**

**Madeleine Brehaut** is a third year studying civil engineering and provided design and structural analysis to the project.

**Katie Gronsky** is a graduate student studying urban and environmental planning and provided design and analytical planning methods to the project.

**Christina Leas** is a fourth year and provided her knowledge from studies in anthropology and global development.

**Yutong Li**, a student from China, is a fourth year studying religion and philosophy and provided educational and collaborative assistance to the project.
Health, Wellness, and Environmentalism: Expanding an After-School Club at Burnley Moran Elementary School

Kelly MacDonald, Sarah Leser, Caroline Herre, and Vanessa Ehrenpreis

This year long project involved working with Burnley-Moran Elementary School (BME) in Charlottesville, VA to execute an extracurricular club called “Healthy Habits”. As an extension of a previous Jefferson Public Citizens grant, the project sought to continue the club and expand students’ exploration and knowledge of environmentalism, exercise, and nutrition. The major goals were to continue the established club, to examine ways to better use the school’s nature trail, and to integrate the garden and trail into BME’s infrastructure. To achieve this, a weekly club was held for third and fourth graders with lessons and activities using both the garden and trail. At the midpoint of the research, results indicate a positive relationship between students’ learning and the curriculum, garden, and trail, highlighting the potential for outdoor wellness education to inspire healthy lifestyle choices. Upon completion of the research, the findings and curriculum will be shared with the community partners at BME and City Schoolyard Garden. We hope this work will contribute to the discussion of schoolyard garden and outdoor education at BME and inform implementation of similar programs throughout Charlottesville.

Introduction

The world currently faces a variety of serious problems, including environmental degradation, childhood obesity, food insecurity, and educational inequity. There are many proposed solutions to solve these complex and interconnected issues, but schoolyard garden programming has particularly risen to prominence (Desmond, Grieshop, & Subramaniam, 2004; Edible Schoolyard, 2015). The US Centers for Disease Control and Prevention (2014) notes the importance of schools in fighting these problems as they provide “a safe and supportive environment with policies and practices that support healthy behaviors”. Studies show that garden-based learning positively impacts students’ academic performance, attitudes toward healthy foods and nutrition, and environmental education (Desmond et al., 2004; Gibbs et al., 2013; Williams & Dixon, 2013). The 2014-2015 Healthy Habits Club at Burnley Moran Elementary School (BME) continues and expands the garden-based after-school club previously established by City Schoolyard Garden, a 2013-2014 JPC team, and BME teachers Rachel Savoy and Jessica Spears. The club promotes environmental stewardship, healthy lifestyles, and physical activity through the use of the schoolyard garden and nature trail. Our team has begun to examine how this recently added nature trail can expand the content and enhance the effectiveness of the lessons. The major research interests are to evaluate and improve the effectiveness of the club (through pre and post assessments),
to discover ways in which to use the trail for lesson planning and student engagement, and to better integrate the garden and trail into the school’s infrastructure.

**Methods**

The Healthy Habits after-school club was advertised to all third and fourth grade students via activity folders (folders that contain school announcements and opportunities that are sent home with students). From the pool of applicants, 25 club members were chosen by the BME instructors, Jessica Spears and Rachel Savoy. Factors influencing selection included the students’ socio-economic status, behavioral record, and interest in the subject. Students not selected for the club would be first on the list to be selected the following semester. The first two weeks of the club were used as an add-drop period, where students could switch into another after-school program if they were not interested in continuing with Healthy Habits. Throughout the semester there were consistently 18 to 20 students at each club meeting. Slight variation was due to students’ absences for reasons such as sick days, appointments, and other excused absences.

Over the course of the semester Healthy Habits met a total of eight times, with each club meeting lasting approximately an hour and forty five minutes. Lesson plans for each club were developed week-by-week to make curricula flexible and pertinent, though every club meeting followed a basic structure to give students continuity. After check-in students were led through a physical exercise, such as a trail run or group physical activity stations like jumping jacks or stretches. Following this, students were typically broken into groups of five or six for the lesson portion of club, which was divided into different learning stations. Stations were used to effectively manage all of the students and give them more individual attention. In each small group students were often asked to share their observations, thoughts, and knowl-
edge to create an engaging atmosphere of discourse. Once the lesson was complete, all the students reconvened for snack and journal time. Personal journals were used to keep track of students’ progress and provide an opportunity for creative expression. Students recorded club activities like personal reflections, food observations, and recipes in their journals. Additionally, following each club, we posted a synopsis of the activities we complete in that session on our online Healthy Habits blog to document our work and share our curriculum with parents and community partners, such as City Schoolyard Garden.

To measure the effectiveness of Healthy Habits’ curriculum, basic pre and post assessments were given to each student at the beginning and end of the semester. The assessment contained ten short answer and fill-in-the-blank questions. The students’ pre assessment scores were compared to their post assessment scores to gauge their progress and identify any gaps in the curriculum. Students’ journals were used for supplementary analysis if a post assessment question was left unanswered. All team members were certified by the Institutional Review Board to comply with the standards for research on human subjects. In addition, a parent permission slip was approved by the IRB and was required for attendance at the first day of the club.

As part of the lesson-planning research, we attended the North American Association for Environmental Education’s 2014 Conference in Ottawa, Canada. By attending different sessions and presentations from environmental educators, we learned about topics such as effective pedagogical methods and environmental curriculum development. We also received some useful teaching materials, such as magnifying glasses that have since been used for hands-on nature exploration. The conference allowed us to obtain external ideas from professionals in the environmental education field, enhancing the quality of Healthy Habits.

### Results

Overall, the students’ scores increased by 5.82% from the pre assessments to the post assessments. When broken down by question, some of the questions on the assessments changed considerably more than others. Questions dealing with types of plants and the science behind plant growth - questions one, two, and three - changed by 10.52%, 5.92% and 2.63%, respectively. Question

### Pre and Post Assessment Scores

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*Pre and Post Assessment Scores*
three, which asked directly about compost, was one of the two questions where a slight decrease over the course of the semester was found. Questions four through seven asked about healthy food and nutrition, and an 9.47%, 10.53%, 5.26%, and 6.58% change was calculated within these questions, respectively. Question eight showed no change because no students answered the question incorrectly in either the pre or post assessment. Questions nine and ten referred to exercise. Minimal changes were recorded on these questions, 5.26% and 1.32%, respectively.

Discussion

Pre assessment scores varied vastly by question, indicating strong background knowledge on topics with higher scores (e.g. questions one and two). In addition to this, there was substantial improvement in the average score of these questions when comparing the pre and post assessment grades. This could be a result of background knowledge combined with successful lesson plans that focused on these specific topics. For question one, no lesson plan expressly focused on seasonality. This subject did come up indirectly in some lesson plans (e.g. in lesson plan three we extensively discussed the plant life cycle and dealt with many different types of plants), but we never had a lesson explicitly devoted to seasonality. The scores may still have been high largely because of personal experience with the issue. For question two however, we conducted a lesson that directly focused on the topic. The second lesson was on kale growth, care, and harvesting. Below is an excerpt from a student’s journal who wrote the following when asked to reflect on the lesson that day:

This journal entry indicates that the lesson successfully taught or reinforced this knowledge for this student. In contrast to this, the responses to question three had much lower averages than most other questions for both the pre and post assessments. This was likely a result of lesson planning that only indirectly dealt with composting. Unlike plant care, we never had a lesson specifically devoted to the importance of composting, and students likely had less personal experience with it. This will be something we deliberately focus on next semester to see if the lessons can improve this area of knowledge.

Scores for questions four and five improved substantially on post assessment responses, likely resulting from the second club meeting’s farm to plate lesson. In this lesson, students used coloring sheets to explore the various steps of food production,
discussing how some steps might differ if food was grown locally or if it was produced farther from where it is consumed. To further reinforce this idea, students then participated in a relay, running different distances and encountering different obstacles to demonstrate food miles and transportation. While assessment results show that this discussion served to clearly illustrate where food comes from for most students, scores for question five about the difference in local food and food from a grocery store remained relatively low, though improvement was shown. This is likely due to the fact that food miles and farm to plate are both abstract concepts harder to grasp for young students and because this idea was discussed early on in club curriculum, long before the post assessment was issued.

No one lesson plan was specifically devoted to discussion of healthy eating habits (question six, seven, and eight), but instead these lessons were reinforced weekly as we provided students with healthy snacks and discussed what they were eating at each club meetings. Additionally, students were provided the opportunity to help produce their healthy snack through a cooking workshop at one club meeting. As indicated by a lesser difference in pre assessment and post assessment scores for these questions when compared to others, having a lesson specifically about a given topic may increase students' learning and ability to grasp a concept, but practicing a healthy habit routinely week to week still functions to teach students about healthy habits.

Questions nine and ten deal directly with exercise. Although there was little change in the responses of the questions, the students seemed the most enthusiastic about the parts of the lessons plans that involved getting outside and moving. Schools are reducing recess time, and the lesson plans attempted to combat this (Garner & Ramstetter, 2010). Although the scores do not reflect a greater knowledge about the reasons that exercise is good for students, a process called open coding reveals a common theme among the club members. Open coding is a method of analyzing qualitative data by highlighting common themes in written journal or assessment entries. The final question on the post assessment (unscored) asked students to describe their favorite part about the club, and many cited the active parts of the lesson plans as their favorite. Specifically, every club meeting, the students would run around the ¾ mile trial and do different exercises at each stop. Another popular element of the club was “veggie yoga” where the students practice balancing and forming different vegetables through the poses - broccoli, oranges, lemons, asparagus, etc. The students started taking the initiative to invent their own veggie yoga moves. The excitement about outdoor education and getting exercise translated to overall excitement for the club.

The research and results are limited in that only quantitative data was analyzed. Future findings could be improved upon through the incorporation of qualitative analysis of students’ reflections and answers of open-ended questions in their
journals. However, in this project, journals were primarily used for student self-reflection rather than for gathering of data. Students were not asked to complete specific tasks or answer fact-finding questions in their journals. For this reason, analyzing qualitative data now would have major gaps and provide few results, but incorporation of qualitative data in future research would provide valuable information for analysis. Additionally, analysis of this research is limited by the lack of a control group to compare the knowledge students gain through enrollment in the club to knowledge students may obtain through other means. Some improvements in knowledge about topics discussed in the club could be due to external factors, so in the future it would be useful to arrange a control group of students not enrolled in the club to take the pre and post assessments.

Though the research is also limited in that it addresses lifestyle changes that cannot be fully measured within the timeframe of the club, throughout the progression of the club week to week students exhibited increased interest in trying new foods, exercising on the trail, and planting and harvesting in the garden. This increased interest during the club and the increase of knowledge measured through assessments indicate that students have likely learned valuable healthy habits that will be carried throughout life and foster the development of long term healthy lifestyle changes. Students learned exercises they were eager to repeat week to week and were given a recipe book at the end of the club to encourage the continuation of making healthy snacks at home. We hope that the excitement revolving around healthy habits students expressed week to week in the club will be carried over into their daily interactions with and choices about eating, exercising, and interacting with the environment for the rest of their lives.

The primary goal of this project was to educate students about healthy habits such as environmental stewardship, healthy eating, and physical activity through the use of an already established
schoolyard garden and the incorporation of a nature trail circling the perimeter of the school. An after-school healthy habits club, schoolyard garden, and nature trail present a viable way to provide students with opportunity for experiential hands on learning, enhancing their knowledge about and exposure to ideas about healthy lifestyles at a young age. Through review of students’ assessments and journal entries, it is apparent that students gained an increased knowledge about environmentalism, nutrition, and exercise through participation in the Healthy Habits club.

As our work is conducted within a public elementary school, the research timeline is consistent with the school calendar and will continue during this next semester. We are excited to work with a new group of students, learning from the results of the first group of assessments and creating new ways to further enhance students’ learning about healthy habits. As the weather improves, we hope to focus on development and integration of the nature trail into club curriculum. Additionally, at the completion of our research, we will compile the lesson plans into a booklet to be distributed among teachers at Burnley Moran, hoping that teachers will use the activities and lessons to incorporate the trail and garden into recess, physical education programs, and everyday learning.

Additionally, we have formed a new group of U.Va. students to continue work with BME, the garden program, and the nature trail next year. This group will continue to administer the weekly Healthy Habits Club, focusing on making the club a long-term sustainable part of the life of BME and working to integrate the garden and trail further into everyday use among teachers at the school.

References


Biographies

Kelly MacDonald is a fourth year student from Pennington, NJ studying Environmental Science and Global Development Studies.

Sarah Leser is a fourth year student from Newport News, VA studying Anthropology and Sociology.
Caroline Herre is a third year student from Norfolk, VA studying Economics and Landscape Architecture.

Vanessa Ehrenpreis is a third year student from Harrisonburg, VA studying Environmental Science and Environmental Thought & Practice.

Acknowledgments

We would like to thank City Schoolyard Garden; the Burnley-Moran Elementary School community, particularly Jessica Spears, Rachel Savoy, Matt Darring; and our advisor Ellie Wilson.

Appendix

Healthy Habits Pre/Post Assessment

Crop Care/Seasons
1. Name a vegetable that you would eat in the summer.
2. Name four ways to take care of a plant.

Food Sources/Environmental Stewardship
3. Why do we compost?

Cooking/Nutrition
4. Where does food come from?
5. What’s the difference between food from the grocery store and food from a local farm?
6. Describe a healthy and balanced meal.
7. Why do you eat?
8. What is something you like to cook?

Exercise/Mindfulness
9. Name three ways to be active.
10. Why is exercising good for you?

Reflection (Only included in post-assessment)
11. What was your favorite part of Healthy Habits?
Water Distribution Systems: A Capacity Factor Analysis of Rosa Grande, Nicaragua

Kit Guncheon, Brendan Kelley, Angela Liu, Brittany Major, Benjamin Matthews, Wilson Ruotolo, and Meghan Smith

Access to clean water in developing areas reduces the incidence of disease and saves resources, allowing development to proceed towards more significant long-term goals. Unfortunately, the systems put in place by development organizations to distribute water in many rural areas often befall a range of problems that quickly render them ineffective. Our research focused on the community of Rosa Grande in the North Atlantic Autonomous Region of Nicaragua, and serves as a case study for examining how and why these projects fail over time. We expanded a previously determined list of capacity factors (Bouabid & Louis) that predicts a water distribution system’s overall success, and applied this analysis to Rosa Grande. We further investigated each capacity factor to determine a complete picture of why failures occurred and then used it to devise a step-by-step solution. We hope that this case study can be applied to similar situations to both help prevent problems in the construction of water systems and to determine how to repair and implement maintenance plans for similar existing systems.

Introduction

According to the World Health Organization 2014 report “Progress on Drinking-Water and Sanitation,” Nicaragua is not on track to meet the Millennium Development Goal regarding clean water and sanitation improvement (WHO). Many communities lack access to potable water and suffer from health problems such as tuberculosis and diarrhea (INIDE, MINSE). Rosa Grande, Nicaragua is an example of one such community. A majority of community members receive unsanitary and an inconsistent supply of water to their homes from a water distribution system installed in 2005 with funding from the municipal government. Measurements of water quantity and quality indicated an unpredictable supply and poor quality. The purpose of our research was to identify the primary design and implementation elements that caused these deficiencies in the first place and then use this knowledge to build a short and long term solution for the community.

Methodology

Our work involved both the collection of quantitative service data characterizing the water distribution system and a qualitative description of the social and cultural capacities of the community.

Quantitative

Water samples were taken from the source and at waypoints along the pipeline.
Sample points included the spring source, the main storage tank, a representative grouping of family owned faucets (including both major pipe branches), and the main river. This data demonstrated the quality, quantity and flow route of the water. Samples were transported to URACCAN University in Siuna where Dr. Lleana Mairena performed water quality tests.

**Qualitative**

In order to fully address the critical capacity factors, interviews were conducted to assess the attitude of the community. This data collection was focused on three major groups: the beneficiaries, the water committee members, and the associated Bridges to Community (BtC) staff. Each interview was recorded and executed by two team members as well as a translator from BtC. The focus for each group of interviewees was as follows:

**Beneficiaries**

From community members who benefited from the distribution system, we learned how the majority of the community used water on a daily basis; particularly the point of use habits of each family. We asked for general estimates of supply statistics, how or if they treated the water, and their overall opinions regarding the water’s cleanliness and accessibility. We were then able to compare their perceptions with data collected in the field.

**Water Committee**

We met with four administrators to ask about the history of the system, what kind of training was provided for the committee, and the effectiveness of current operation. We hoped to identify ways to improve communication and education by listening to the different perspectives of the committee members.

**BtC Staff**

We interviewed our BtC translators, BtC’s water engineer, and the regional director of BtC. They had experienced many of these same kinds of issues with water systems in...
their hometowns or on other projects. They had also monitored the water distribution system and provided some further political and technical information about how the installation was originally organized. Consequently, our interview questions were related to these perspectives and helped us understand how Rosa Grande compared to Nicaragua as a whole.

**Results**

*Water Quality Data*

We analyzed water quality in samples collected at sixteen different points along the water distribution system. We found that the fecal coliform levels were well above safe drinking levels (anything over zero UFC/100ml is unacceptable) (World Health Organization, 123).

Because the system is a series system (see Table 1), any contaminants in the system near the source are present throughout the system.

![Water Distribution System in Rosa Grande](image)

Table 1 - Schematic map of water distribution system in Rosa Grande, Nicaragua

We observed significantly higher levels of coliform in water samples collected from houses by the river. In addition to fecal coliform, we also tested for turbidity, pH value, conductivity, hardness, cyanide, nitrate, nitrite, and sulfate levels; however those values were at a safe level for the community (all below SDLs).
Interview Responses (General Themes by Category)

- **Service**: On average people used three, twenty liter buckets a day for a family of four to six members. Most beneficiaries reported that they were very appreciative of the water system, comparing themselves to other communities that lacked water infrastructure. Most beneficiaries also recognized that the system was not working as well as it did shortly after installation, mentioning that it was “dirty” or causing children to be sick.

- **Sociocultural**: Beneficiaries reported similar water uses, such as cooking, washing clothing, bathing, and drinking. Multiple beneficiaries noted that “potable” means water arriving through “tubing” to the community.

- **Environmental**: All beneficiaries interviewed reported that they conserve water but that they suspect others do not. Almost all beneficiaries interviewed said they believed their water is potable.

- **Institutional**: With respect to the water committee, respondents reported that the water committee was not doing an effective job. Many mentioned the regularly changing members and lack of motivation for being on the committee as problems. If a pipe breaks near the home, beneficiaries are expected to fix the problem on their own, but if a pipe breaks within the general system, the water committee is alerted and asked to fix the problem.

- **Human Resources**: Many community members were originally involved in imple-
menting the water system by providing labor.

- Economic/Financial: The monthly payment for water is ten C$, and most beneficiaries agreed that this is reasonable and would most likely pay more if their service was improved.
- Technical: Not many beneficiaries used chlorine to purify their water, although some houses reported using a filter occasionally.

**Capacity Factor Analysis**

Eight major capacity factors determine the success and failure of water distribution systems in a developing area according to the system established by Professor Garrick Louis of the University of Virginia. A community is given a rank from one to five based upon its weakest factor (9-10). Scores were based upon the answers provided by the community, the quantitative water data collected, and similar cases studied by Professor Louis. The analysis that we compiled is depicted in Table 2.

When ranking the village of Rosa Grande, we identified the “Institutional” capacity factor as the weakest. This was due to the lack of any governmental presence and the minimal impact of the community’s water committee. This rating was then altered because we believed that the abilities of the water committee were more accurately limited by the remaining capacity factors. Given sufficient resources, they could rise to handle its new responsibilities, thus, the system in Rosa Grande should be rated by its lowest technical and economic capacity factors of two.

**Discussion**

**Distribution/Water Allocation**

The problems faced by the community began with an underlying misconception by both the builders and the community members: the system itself was not intended to provide clean water for every household task. Rather, the system was installed so that the community members could have access to filtered water when they actually needed potable water, such as for drinking and cooking. Then, all other community tasks, such as cleaning and washing clothes, could be supplemented with unfiltered water from several nearby sources. Consequently, it is imperative that future efforts make it clear from the outset exactly how much water the system should be providing under ideal conditions per household. Methods for measuring water use per household should be made available.
Insufficient Resources/Pipe Maintenance

The community does not have the resources to properly maintain the system. Though some community members have the skills to replace pipes and re-caulk connections, pipes are generally not replaced unless they cease to function entirely. Consequently, the entire system has become progressively less and less effective due to untraceable leaks and other minor issues. Though the community is rural and under-financed, it is possible for them to acquire the necessary materials for repairs. As is, the water committee collects regular payments from the beneficiaries for maintenance, but the amount is too small, even though the community is relatively low income. The water committee previously did not understand that a maintenance budget is crucial to the successful operation of a water system, but they are now acting to increase the monthly collection fee. Looking forward, the builders should communicate with community members exactly how a system should be serviced each year and help design a sustainable payment plan.

Education/Training/Water Committee

Even more problematic than the lack of pipe maintenance is that the community does not understand how to properly use, maintain, or operate the filter that was installed. Although slow sand filters, such as the filter installed in Rosa Grande, are durable, they do require minimal maintenance for continued operation. Unfortunately, the beneficiaries did not receive training on how to service the filter at the outset. Future project planning should schedule a designated time period for training the community how to use the installed system.

Water Sanitation Practices/Storage

Finally, poor water quality is made worse by poor point of use habits. Most community members pay little heed to their water storage vessels beyond simply removing visible debris; consequently, microbial growth manifests unchecked. This cultural mindset negates any attempts at filtration upstream of the storage vessels. Thus, it is imperative that there are social and cultural changes made to support new technical capacities.

Solution

Our solution involves five stages: procurement, treatment, initial storage, distribution, and point of use storage.

1. Procurement

First, the water source itself should have a concrete retaining berm installed around its perimeter to prevent the surrounding farm runoff from flowing directly
into the water system. Secondly, it must be explained that the filtered water should only be used when it is consumed and water from alternative sources should be used whenever possible.

2. Treatment

Second, treatment of the water must be re-addressed. The filter installed originally will only work with a significant investment of labor and resources. This effort should begin as soon as possible and should involve training community members in both the setup and regular maintenance of the filter. Since such a large endeavor will not be a quick feat, we also propose that a short term solution of regularly chlorinating the water storage tank be implemented in the interim period.

3. Storage

Third, a temporary, secondary storage container should be constructed to facilitate the aforementioned chlorination process. It is imperative that a dual stage system be implemented so that the chlorine has time to take effect, unlike the haphazard administration of the chemical that the system sees now.

4. Distribution

Fourth, beneficiaries need training on how to clean, maintain, and replace the distribution pipes. While some maintenance and repair has been performed by community members over the years, it has always been on an as needed and ad hoc basis. The beneficiaries need expert instruction on what to do for any eventuality and, for longer term success, must plan out where and how to get the items needed for a given repair. This will require time, money, and communication to hire the outside water organization, but the motivation will need to be initiated from within the community.

5. Education and Training

Fifth, and possibly most difficult, it will be imperative for the community to improve overall point of use habits. The beneficiaries have already demonstrated a general understanding of the concept of clean water and how it is more complicated than simple turbidity. This is a critical first step in improving their health practices and makes them very receptive to employing point of use water filtration devices. Unfortunately, they do not transfer that knowledge to their storage and use habits, rarely cleaning or covering water containers and hardly differentiating between cleaning water and safe drinking water. Such oversights are understandable, as they do not currently have any discrepancies in water quality among their potential sources, but it is a cultural shift that must be made for any potential technical solution to actually make a difference.
References


Biographies

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The Grundy Teen Center Project: An After-school Center in Grundy, Virginia

Jessica Baralt, Amelia Brackmann, Callum Gordon, Asher McGlothlin, Todd Stovall, Chris Wallace
Graduate Student Mentor: Brad Brogdon
Faculty Advisor: Seth McDowell

The Grundy Teen Center Project is a collaborative design/build project between the University of Virginia’s School of Architecture and the Grundy Town Council. Begun in the Spring of 2013, the project aims to facilitate the design and construction of an after-school youth center in a rural town in central Appalachia. The design process revolved around frequently receiving input from high school students and their families, politicians, as well as other groups in the area to ensure that the final design would satisfy the desires of all stakeholders.

Introduction

In 2001, the Grundy flood control project began in the rural coal mining community of Grundy, Virginia, and sought to protect the town from future natural disasters. The town had previously seen two major floods, one in 1957 and another in 1977, that caused irreparable damage to much of the downtown core. This project saw the destruction of a large portion of the downtown core’s buildings and proposed to relocate the programs held within them to a new town center located on the opposite side of the Levisa River (Mullins and Mullins, 2007). One of the buildings that was razed during this project was the Grundy Teen Center.

The former teen center was located in the heart of downtown Grundy in a building that had previously functioned as a department store. It primarily served to provide local youth with wholesome entertainment on weekends but also offered after-school tutoring to a small number of students. The teen center also provided the town with an indoor space where large events could be held. As restitution for the teen center’s destruction, the town received some base funding for the construction of a new teen center from the Federal Emergency Management Agency (FEMA). In 2012, the Grundy Town Council partnered with the University of Virginia’s School of Architecture to design a new teen center that would not only help to replace the programs of the old structure, but to create a building that could offer a vast array of after-school programs and serve as a monument to the town’s unique cultural heritage.

The Grundy Teen Center will satisfy demand for educational programming that would introduce the youth to curriculum that currently is not offered at the local high schools. The area is currently facing issues with its educational systems. The 2010 U.S. Census data revealed only 65.8% of Buchanan County citizens over the age of 25 have a high school diploma. In contrast, 86.9% of all Virginia residents over the
age of 25 have a high school diploma. Additionally, census statistics also show only 7.6% of Buchanan County residents over the age of 25 have a bachelor’s degree as compared to 34.7% of residents throughout the state of Virginia (U.S. Census, 2010). Preliminary talks with teenagers in the community have generated excitement based on the proposed educational after-school programs. Multiple studies have shown a positive correlation between after-school programs and an increase in graduation rates. Members of LA’s BEST after-school program are 20 percent less likely to drop out of school compared to matched nonparticipants (UCLA National Center for Research on Evaluation, 2007). Not only do students graduate, they often excel in school when involved in after-school programs. Students who participated in North Carolina’s Young Scholars Program that had at least 280 hours in the program averaged double-digit increases for proficiency in both math and reading. The program also saw promotion rates rise by 38 percent (Z. Smith Reynolds Foundation, 2006). Due to Buchanan County’s widely dispersed and small population, it is difficult for the school to offer courses outside of the base state-required curriculum. We believe that by offering after-school courses to students in fields they are interested in, we can also influence them to graduate high school and pursue a career in a field they may otherwise may have never been introduced to.

In order to achieve a final structure that would successfully accommodate after-school activities and incorporate a design representative of the town of Grundy, our team decided it was necessary to keep the community closely involved throughout each stage of the design process.

**Methodology**

Our research began with an initial survey in the spring of 2013 of all high school students in Buchanan County (Grundy is the county seat of Buchanan County). The written surveys were distributed to students by professors and community members, and included questions on favorite activities outside of school, teen center activities, and favorite architectural works. After analyzing these sur-
veys, we took a site visit trip to Grundy to discuss the survey results with members of the Grundy Town Council and to survey the project site.

During a seminar class in the fall of 2013, we developed a book of precedents featuring architectural projects and existing teen centers for presenting to high school students, the congregation of New Hope Christian Church, and the Grundy Town Council in order to receive feedback on what structures were most appealing to them. After receiving this input, we developed two initial concept designs that were presented to the Grundy Town Council at the conclusion of the semester.

It was during an architectural studio held in the spring of 2014 that we utilized the town's input for the development of five separate prototypical designs. The first iteration of these concept models was displayed to the town council, local high schools, and a local Boy Scout troop during a site visit trip in early February 2014. We further developed these designs with the input of these groups over the course of the spring semester. The final design iterations from this studio were presented during a site visit trip in early September 2014. Presentation groups on this visit included the grades 9-12 students of Grundy High School, grades K-12 students Mountain Mission School, the Grundy Town Council, and a large portion of the town’s population at a festival held on the proposed project site. Through conversations with community members, it became clear that specific elements from three of the studio’s five designs were well-liked by the community. For the past five months, our team has combined these preferred elements to create one composite design, which was presented to the Grundy Town Council and students at Grundy High School on February 9-10, 2015.

*Presenting design ideas to students at Grundy High School*
Results

Our final design was presented to the Grundy Town Council during its February 2015 meeting. This design is the culmination of all of our research on the area’s history and the needs and desires of Buchanan County’s citizens. Town Council members and members of the community were happy with the project’s final design. Grundy’s Town Manager James Keen said, “I like what you all have done here, it looks like you’ve incorporated all of the suggestions we made at the last meeting” (J. Keen, personal communication, February 10, 2015).

Our final design is located adjacent to the Grundy Community Center in the heart of downtown Grundy. It has two entrances, one from the sidewalk and one that will be reached from an interior court that is easily accessed from the community center’s existing parking garage. A large roof structure stretches over the center’s courtyard, which will allow outdoor space to be utilized in times of inclement weather. The unique exterior facade system has been derived from a classic bluegrass song, “Mountain Dew,” making a direct connection to the thriving bluegrass culture in Grundy.
today. The system is composed of reclaimed barnwood in 16 foot sections, with the length, width, and placement of each board representative of musical notes in the song.

The center has a public space that can be shared by community residents of all ages, and a more private wing containing multiple programmed rooms. The public section of the building features a large multipurpose room accommodating activities such as weekend dances and concerts for teens, evening dance classes for the youth and adults, town council meetings, and weekly bluegrass jams. We have been in talks with a group that already offers evening dance classes for adults that has expressed great interest in being able to use the space. The Grundy Town Council has also expressed interest in holding some of its meetings in the space instead of their current meeting room, which has limited seating, and has suggested moving weekly bluegrass jam sessions to this room, rather than their current Grundy Plaza hallway venue. The room will have a large brick mural that will depict scenes of the town’s history and culture, as well as a wall filled with black and white images of the area’s residents from the past and present, paying homage to the town’s past while also celebrating its future.

The linearized section of the building focuses on after-school programs for the area’s youth. This part of the building features four rooms: a kitchen equipped to be used for culinary classes, a lounge with sofas and video game consoles, a computer lab, and a music recording studio. These programs were featured based on the teen’s greatest interests. While some curriculum will have to be developed for culinary and technology classes, there is already an existing music education program in the area that currently has over 300 active students. This is the PICK (Playing Instruments Changes Kids) Program which focuses on teaching students how to play bluegrass instruments. The operators of the PICK Program have expressed extreme interest in

![Final model of the Grundy Teen Center](image)
occupying the teen center once it is complete as they currently have no center of operations but travel from school to school throughout the county in order to provide after-school music lessons.

The Grundy Town Council plans to have the building managed by one full-time employee and staffed by several part-time high school-aged employees. It also plans to have the center’s programs managed by the Buchanan County Boys & Girls Club. This organization has over 350 active youth participating in its after-school activities but does not have a center of operations, so it is having to use local high schools for its activities.

In the spring of 2015, we will be presenting the town with a presentation package including a booklet explaining the teen center’s design and a scale model that can be shown to potential donors. We will also aid the town in applying for grants to fund the teen center’s construction.

Discussion

We see the teen center as being a space not only for teenagers, but for the whole community to gather and share ideas. We believe that this structure has the potential to foster community conversations that can lead to progressive thinking for the town’s future. However, no building alone can change a community; this must come from the citizens themselves. We have kept the community involved in every step of the design process and designed elements of the building to be constructed by local volunteers, fostering a sense of ownership over the teen center once it is completed. Our hope is that at the completion of the center’s construction, the work will stand as a monument of what the community can accomplish when its citizens come together and provide a precedent for future projects with similar positive impacts.

References


**Biographies**

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This project would not have been possible without the help of our fearless leader and faculty advisor, Seth McDowell. We would also like to thank two other Architecture School faculty, Peter Waldman and Suzanne Moomaw, for their invaluable advice and expertise in the carrying out of this project. Lastly, we would like to thank the most important contributors of this project, the people of Grundy and Buchanan County whose advice and incredible culture drove this project’s design. We have been honored to be the facilitators of a design they have created and we hope that they will be pleased with their new teen center once it is constructed!
Making Rompiendo Fronteras Self-Sustainable

Elisa Montealegre, Emily Mordecai, Emily Anthony, Andrea Kleid and Melissa Picon

Since the establishment of the Hermanas Unidas Rompiendo Fronteras mentoring program in Managua, Nicaragua in 2013, 24 participating high school girls have mentored 24 5th grade girls considered at risk because of low family income as well as increased their own awareness of socio-economic differences in Nicaragua, completed a social development and college preparatory curriculum, and gained vocational and business literacy skills (Arguello et al., 2014). The focus of the current JPC project was to bring the mentoring program into a second major phase of development: making the program self-sustainable. In order to do this, we (1) provided program stakeholders with the structure and resources needed to develop a local system of program administration and (2) revised the relationship between Rompiendo Fronteras and the Young Women Leaders Program to secure a long-term partnership.

Introduction

Many of the adolescents who live in Nicaragua face economic and environmental risks to their health and happiness, including unstable family conditions and temptations of drug and alcohol use (Cunningham, 1998). Over the past several decades, researchers have found that one-on-one youth mentoring programs have succeeded in steering youth in other countries away from these obstacles and toward happy, healthy lifestyles (Rhodes, 2002). The Young Women Leaders Program (YWLP), founded in 1997 at the University of Virginia (UVa), is a group and one-on-one mentoring program that pairs college women with local middle school girls for a year of mentoring. Outcome evaluations indicate that the program benefits both the middle school girls (Henneberger, Deutsch, Lawrence, & Sovik-Johnston, 2013) and college women (Lee, Germain, Lawrence, & Marshall, 2010). Each year, YWLP succeeds in helping its members gain an increased sense of confidence, develop broader sets of interpersonal skills, and strengthen their senses of self-understanding.

In 2013, a Jefferson Public Citizen (JPC) team composed of M. X. Arguello, B. Cesaratto, L.A. Haley, E. Montealegre, J.S. Peifer, and R. Rao founded the program Hermanas Unidas Rompiendo Fronteras, or “Sisters United Breaking Boundaries,” in Managua, Nicaragua. Modeled after YWLP at UVa, Rompiendo Fronteras matches high school girls from a high-income school, called Lincoln International Academy (LIA), with 5th grade girls from a low-income school called Centro Educativo Sagrada Familia. The program seeks to optimize the leadership potential of mentors and mentees, or “Bigs” and “Littles,” and to encourage them to create a global sisterhood that transcends socioeconomic and cultural barriers.

Following an evaluation of Rompiendo Fronteras in December of 2013, the 2013 JPC
Team reported that the program started with success. At the end of the first semester the high school mentors or “Bigs” in the program reported that they continued to meet with their mentees or “Littles” regularly and that doing so helped them gain an increased sense of empathy and awareness of socioeconomic disparities (Arguello et al., 2013). However, much of the success of the program could be attributed to the continuous involvement of the JPC Team, who communicated with program leaders weekly via email and Skype to organize logistical information, plan program events, assist in problem resolution processes, and manage the program’s budget (Arguello et al., 2013). While this intensive partnership ensured the success of the beginning stages of the program, this level of involvement and support would not be sustainable or ultimately conducive to Rompiendo Fronteras developing its own local identity, securing its own sources of funding, and ensuring investment in the program from school administrators in Nicaragua. On the other hand, letting the program fail because support was promptly withdrawn from the JPC would likely have negative long-term consequences. Research shows that there can be community resentment towards future aid programs when an aid program initiated by people outside the community is short-lived (Lodl & Stevens, 2002).

Thus, it was important to investigate ways to support the development of Rompiendo Fronteras as a sustainable program in Nicaragua without having to rely on the level of resources provided by the JPC team. Sustainability for youth programming can be defined as “effectively leveraging partnerships and resources to continue programs, services, and/or strategic activities that result in improvements in health and well-being of adolescents” (The Office of Adolescent Health of the US Department of Health and Human Services [HHS], 2013). Based on a review of the literature on developing self-sustaining programs (HHS, 2013), the critical components of a self-sustainable program can be synthesized in the following model (Figure 1).

Our JPC Team used this model as we worked to devise a practical answer to the question: “How can Rompiendo Fronteras be transformed into a self-sustainable program that can survive without depending on a JPC team?” This goal required us to shift authority over the program from the JPC Team to the local stakeholders of Rompiendo Fronteras themselves. Using the model above and feedback from the leaders of Rompiendo Fronteras in Nicaragua, we developed the following plan for achieving a locally powered framework of sustainability: 1) assemble a support team for the program of school administrators, past participants, and club leaders in Nicaragua, 2) create
program manuals and other resources that the support team could use to run the program successfully, and 3) revise the relationship between Rompiendo Fronteras and U.V.a to increase Rompiendo Fronteras’ sense of ownership of the program while also strengthening their ties with the larger Young Women Leaders Program community.

Approach

Recent studies on creating frameworks for program sustainability have emphasized the importance of “streamlining management systems, hiring and training additional staff, and developing program materials during the grant period” to increase the likelihood that the program will continue after funding ends (Stevens & Peikes, 2006). We therefore aimed to create a localized and regulated form of program administration for Rompiendo Fronteras by providing it with resources and improved organizational structure. The first step in this process was to expand the program’s support network by increasing the total number of program stakeholders. Stakeholders have been conceptualized as those individuals “who affect or [are] affected by” the program (Freeman, Harrison, Wix, Parmar, & De Colle, 2010). We identified the following Rompiendo Fronteras stakeholders: the Lincoln International Academy administration, the program facilitators, the program’s previous Bigs, and the program’s current Bigs. We then created an 80-page handbook that outlines various participants’ roles in the program, streamlines the process of selecting and training facilitators, Bigs, and Littles, explains how to implement the program’s curriculum, and details how to carry out year-long program administrative tasks. We also edited the Rompiendo Fronteras curriculum based on the previous year’s feedback from the participants by adding more information about issues that Bigs and Littles were facing in Nicaragua, such as bullying. Lastly, we organized an orientation session to present the handbook to program facilitators and train them on how to use it as an effective guide. We also re-trained Bigs on how to use die-cutter technology, an important innovative tool they use as part of the curriculum. By training these stakeholders to effectively use the resources we created, we hoped to increase their sense of responsibility and confidence in the continued success of the program.

Also indicative of the self-sustainability of a program is the existence of a strong set of collaborative partners (Hanson & Salomoni, 2011). In order to utilize this tool of self-sustainability, we worked to revise the connection between Rompiendo Fronteras and YWLP in order to secure a long-term relationship between the two groups. We reframed the relationship from one of hierarchy (UVa as the source of knowledge) to one of collaboration (participants of both sites as fellow learners). Specifically, we strengthened the ties between these two programs and increased YWLP participants’ connection between the YWLP “sister sites” in Nicaragua and Virginia by: 1) establishing a system of international communication through email contact between
administrators at both sites, 2) facilitating more regular communication between Bigs and Littles from both locations through written letters, and 3) sharing pictures and stories of Rompiendo Fronteras on the YWLP website (ywlp.virginia.edu) so that YWLP “sister sites” nationally and internationally could learn more about the girls and women in Nicaragua. We also formally acknowledged the Rompiendo Fronteras stakeholders’ dedication to the program by conducting a ceremony at the Lincoln International Academy, during which we presented the school with a plaque recognizing Rompiendo Fronteras as an official sister site of YWLP.

Outcomes

Prior to our efforts to make Rompiendo Fronteras a self-sustainable program, stakeholders directed the majority of their questions and concerns to the JPC team. We facilitated a shift away from total dependence on the JPC Team toward independent, internal problem-solving by providing Rompiendo Fronteras administrators and Facilitators with materials and training that equipped them with a thorough understanding of the administrative and logistical components of the program. We almost immediately observed the value of this shift: when a program facilitator left the high school in Nicaragua unexpectedly in November of 2014, school administrators used our program handbook to train a new facilitator. The program handbook allowed the facilitator to quickly become knowledgeable about the program’s mission and administrative needs and ensure the program’s swift continuation.

By increasing internal communication between program stakeholders in Nicaragua, our team has increased their sense of ownership and commitment to the program’s success. As communication between administrators and Bigs increased, so did their excitement about the growth and continued success of the program. Together, they decided to play an active role in obtaining funds to sustain the budgetary needs of Rompiendo Fronteras by created a fundraising club called Apoyando a Romper Fronteras, or Helping to Break Boundaries. Since its inception in August 2014, Bigs have organized a variety of fundraisers and social events to bring togeth-
er Bigs and Littles and to purchase program materials. In addition, the fundraising club has incorporated the die-cutter into its fundraising efforts to make and sell various items, such as handmade Christmas chocolate boxes and Valentine’s Day cards.

With support from a larger network of stakeholders and an improved collection of program materials, Rompiendo Fronteras has become a great source of pride for Lincoln International Academy. Together with members of the administration, our team organized a formal ceremony that brought together faculty, parents, and students to honor mentors for their past, present, and future achievements, and recognize their tie to the YWLP international community. In recognition of both the high and elementary schools’ continued efforts to support the program and in order to solidify the lasting connection between YWLP and Rompiendo Fronteras, we presented both the Lincoln International Academy and the Centro Educativo Sagrada Familia with honorary plaques that hang proudly on their school walls.

Discussion

The Hermanas Unidas Rompiendo Fronteras program seeks the empowerment of young women through one-on-one mentoring, social development, and entrepreneurship. The Bigs and Littles follow an interactive and culturally conscious curriculum, modeled after YWLP’s curriculum, to help foster a strong mentoring relationship. For a year, girls are exposed to weekly themes, which allow them to discover and engage in a variety of leadership skills and techniques such as negotiation and public speaking. Experts have found that youth who have had a relationship with a mentor or mentee report strengthened relationships with their parents, an increased sense of self-worth, and improved academic performance after completing a mentoring program. (Rhodes, 2002) These benefits may be especially paramount to girls in Nicaragua, many of whose living conditions make them susceptible to greater risks to their health, safety, and success (Cunningham, 2008). While research has found mentoring to be an effective means to support the positive development of at-risk youth, it also highlights the importance of the sustainability of these programs and the mentoring relationship: mentees have a much higher chance of achieving positive outcomes if their relationships with their mentors last at least one year (Rhodes, 2002). By sustaining Rompiendo Fronteras, therefore, we worked to improve the chances of positively impacting the outcomes of the girls and young women in Nicaragua participating in this mentoring and leadership development program.

With a stronger support network and set of resources in the community, Rompiendo Fronteras is now on the path to independent management and long-term self-sustainability. The resources and structural changes that our team introduced have launched the program into a transitional phase in which its primary stakeholders are in the process of learning how to lead the program. The initiative that Bigs, facilitators, and
administrators have demonstrated since our team left Nicaragua in August 2014 is encouraging. Some of the early indicators of sustainability are their continued efforts to operate a fundraising club giving back to the mentoring program, and successful recruitment and training of new program participants without the direct help of the JPC team. A program’s level of self-sufficiency is, however, difficult to measure, especially when it is still in relatively early stages of its development. The inability to quantitatively measure the sustainability of the program is the main limitation of this research project. Over time, however, we hope that the program will continue without the support of the JPC team. This will be the only true measure of its self-sustainability.

References


Two-thirds of the world’s disabled population resides in developing countries. Disability in such regions carries severe social stigma, ultimately restricting access to healthcare and education that would improve quality of life and functional capabilities of these individuals. Zambia is a country in southern Africa that has been identified as ‘low-development’ by the United Nations, ranked 163 of 187 countries in terms of human development. Special Hope Network (SHN) is an organization in Lusaka, Zambia that provides therapy and education to children with intellectual disabilities. SHN trains Zambian high school graduates to implement these health services. Our project’s title, Ku-punzitsa Apunzitsi, translates to ‘to teach teachers’ in Nyanja, a Bantu dialect used in Lusaka, and succinctly expresses our mission. Our team travelled to Lusaka to collaborate with SHN in improving teachers’ skills in planning fine motor, gross motor, literacy and math lessons. We sought to understand whether direct teacher training in executive skills related to professional work, namely lesson planning, improved the educational services offered by SHN.

Introduction

This project aimed to improve the teaching skills of Zambian high school graduates working at Special Hope Network (SHN). SHN is an organization that provides...
education and motor development programs for children with intellectual disabilities. Our goal was to improve the services offered by SHN, and, in turn, provide a better quality of life for the children and their families while also combating social stigma against disability in Zambia. Administrators at SHN requested that our team develop a project that would increase the independence and professional confidence of their teachers, all of whom are local high school graduates. The teachers were struggling to plan ahead for lessons and frequently sought the support of administrators; this was decreasing the potential efficiency of the organization. SHN felt that their teachers had the power to improve their professional skills and the services that they offered to students, but needed to be given the tools with which to do so (Lino, 2014).

Our team collaborated with SHN for over a year before arriving in Zambia in order to prepare to implement our project. With the support of our faculty advisor, Dr. Paige Pullen, a professor of Special Education who had previously worked with SHN, we presented a four-week lesson planning skills training to SHN teachers in Lusaka, Zambia. During this process, data was collected on the teachers’ progress. Specifically, the team measured teachers’ retention of material through biweekly assessments, and recorded quantitative and qualitative notes on the teachers’ lesson plans throughout the training.

**Methodology**

SHN administrators specifically identified the need for improved lesson planning skills in order to improve their educational services. We studied lesson planning skills in 14 young-adult teachers using a pretest/posttest design. Pre-assessments were given in the form of surveys at the outset of each lesson we taught to the teachers and discussions with administrators continued into the fall to determine progress and retention. Further assessment included review of lesson plans, which generated qualitative data about the teachers’ planning process and a quantitative score based on how many essential components of a lesson plan were included in the teachers’ lesson. Prior to working with the teachers on lesson planning, our team observed and informally interviewed SHN to gauge their skill levels before the training and lessons. The training program was composed of four weeks of bi-weekly lessons that each involved direct teaching, collaborative discussions and/or activities, and independent lesson planning templates as homework.

**Results**

The goal of the project was to improve the lesson planning skills of the teachers working with SHN. We discuss the results of our efforts in two major categories: deliverables and lesson planning skills of teachers.
Deliverables. The program culminated in an example integrated teaching unit on animals. An animal theme, featuring common southern African wildlife, was selected because it would feature subject matter with which students were familiar and for which books, toys, and games would be easy to find in the community. The integrated teaching unit demonstrated various techniques, scope and sequences, and example lesson plans. The unit was broken into three individual sections that corresponded to the format of education provided by SHN (Figure 2). Each section, fine motor, gross motor, and literature/mathematics, had an individual scope and sequence and corresponding example lesson plans to effectively and efficiently aid teachers in assessing students and providing appropriate lesson plans for their individual needs in the specific subject (Young and Luttenegger, 2014; Pullen, 2009).

In addition to providing the teachers with a full unit of study, we also provided lesson planning forms that contained an appropriate framework and lesson planning sequence (Morrison, 2007; Hopper, 1992; Pullen, 2009). The teachers indicated that they found it easier to plan with these new resources that they used as examples and templates to complete. Teachers found that the forms and examples aided in their ability to plan lessons, noting that the forms guided them to “plan in advance.” One teacher noted that the forms “kept [him or her] on the lesson cause [sic.] it was...[his or her] center of focus.”

Lesson Plans. At the beginning of the project the teachers were unfamiliar with how to write lesson plans. On a pretest of teacher knowledge, the teachers demonstrated little to no knowledge of major constructs of lesson planning. After the professional development and providing the teachers with clear examples (e.g., deliverables), the teach-

<table>
<thead>
<tr>
<th>Concept</th>
<th>Success Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope and Sequence</td>
<td>92%</td>
</tr>
<tr>
<td>Objective</td>
<td>78%</td>
</tr>
<tr>
<td>Advanced Organizer</td>
<td>85%</td>
</tr>
<tr>
<td>Procedure</td>
<td>100%</td>
</tr>
<tr>
<td>Assessment</td>
<td>69%</td>
</tr>
</tbody>
</table>

Table 1: Teacher success rates on various concepts after professional development lessons.
ers were able to define 4 of the 5 constructs we taught with at least a 75% success rate, shown in Table 1.

Furthermore, at the beginning of the project 0% of the teachers provided lesson plans when asked. At the conclusion of the project, 13 of the teachers, 93%, provided at least one lesson plan for review. Several provided multiple lesson plans. The lesson plans also improved in quality over time. We scored the lesson plans on a scale of 0-6 with 6 having all of the necessary components: objective, advanced organizer, method of presentation, closing, assessment, and consideration of individual child needs. At the beginning of the project, mean score on lesson plans was 0. At the end of the project, the mean score was 4.8.

Overall, the program benefited SHN by teaching skills that decreased the teachers’ dependence on SHN’s directions, thus increasing the organization’s efficiency. This will benefit employees over the course of their careers by increasing their professional confidence, creative thinking and efficiency in completing job-related tasks. Such benefit will also improve outcomes for children and families by better equipping teachers with tools to implement therapy and educational services. Were this program applied on a larger scale, it could allow for greater social mobility for people in developing countries who wish to participate in an increasingly global community.

Discussion

Implications. This project will have a long-term impact on several stakeholders: SHN administrators, SHN teachers, students with intellectual disabilities, and the families of these students. SHN administrators will benefit from having more independent and confident employees who are better able to meet job expectations and provide high-quality services to students and their families. Teachers gained knowledge essential to their ability to succeed in their job and experience the joy of seeing their students’ progress and achieve more. Teachers will also feel less overwhelmed because they are better able to plan ahead and have resources available to help them to do so. Because the teachers will be providing improved services to students, we expect to see pos-
itive results in terms of students' mastery of skills and higher levels of achievement and confidence. As students learn to perform more practical and academic skills, they will have a higher quality of life due to increased independence and ability to partake in activities with typically developing family members and peers. This will translate to improved well-being of the whole family; as a child becomes more independent, care-takers have more time to manage the household, care for other children, and earn an income.

It is our hope that this project is the beginning of a sustainable teacher-training program at SHN. We would like to see other students from our university develop a relationship with SHN and continue to work towards developing a comprehensive program that prepares new employees for their job at SHN and also functions as a refresher course for existing employees. From a broad perspective, we hope that such an endeavor will be reproducible for other NGOs that employ local adults as employees, particularly in educational settings.

**Challenges.** Special Hope Network’s staff consisted of 14 teachers, a relatively small sample size to draw conclusions from. This results in statistically insignificant conclusions; however, this was unavoidable since the scope of this was solely restricted to SHN’s staff. Although less than ideal, we feel that the conclusions drawn properly represent the progress observed by ourselves, Dr. Pullen, and the SHN administration.

Another challenging obstacle we faced during this program implementation was determining SHN teachers’ lesson planning baseline. After talking with SHN administrators prior to arrival in Lusaka, we expected the teachers would have more developed planning, literacy, and assessment skills than was actually the case. A lower baseline, along with a culture of rote memorization rather than creativity, altered our overall expectations and outcomes for this program.

As a result of this lower baseline, the planned training program was altered. It was determined that the training would need to be comprised almost entirely of the essential, foundational knowledge necessary for creating a lesson plan. Much of the more advanced material we had planned to introduce was removed, and we had to quickly create a new program and brainstorm effective ways to communicate the material. This was further complicated by technological challenges in Lusaka, namely a very slow internet connection and unreliable equipment. Our team had planned to create PowerPoint presentations and videos to display material visually during trainings, but the community partner’s projector was faulty and the internet connection made it very difficult to assemble visual media. The slow internet also hindered our ability to research peer-reviewed sources to shape our altered training program, so we relied heavily on the knowledge and experience of our faculty advisor, Dr. Pullen.

We learned that a key to a successful project outcome is to be flexible and learn to adapt. However, by the end of our stay in Zambia, we observed great appreciation from teachers with regard to the resources we delivered to them, and felt encour-
aged by the teachers’ improved ability to meet the expectations and needs of their employer.

References

Acknowledgments
In addition to a generous grant from the Jefferson Public Citizens program, our work was funded by multiple grants: Davis Project for Peace, Center for Global Health Scholar Award, the Rodman Innovation Fund, and the College Council fund. We would like immensely thank our faculty advisor Dr. Paige Pullen; our community partners Holly and Eric Nelson as well as the entire SHN staff. We also wish to extend our special gratitude to the community of Zambia.

Biographies
Lauren Baetsen is a fourth year Biomedical Engineering major planning on working as a field engineer at St. Jude Medical after graduation.

Amanda Halacy is a 2nd year CLAS student who hopes to work in the field of international development after graduation.

Joann Judge is a doctoral student in the Kinesiology and Adapted Physical Education and holds a Master’s degree in Education.

Emily Nemec is a fourth year Biomedical Engineering major planning to pursue a graduate degree in Occupational Therapy at Virginia Commonwealth University after graduation.
Building Leadership Capacity through Impact Analysis in Uganda and Rwanda

Claire Councill, Mark Heneine, Lauren Jackson, and Porter Nenon

The objective of this study was to assess the impact of 55 grassroots ventures in Rwanda and Uganda. The team worked with Global Grassroots, an international nongovernmental organization (NGO) that provides leadership training and grant funding to women in post-conflict regions, to both analyze venture impact and test the efficacy of Global Grassroots’ unique development methodology — including training programs that pair business and mindfulness practice to both teach skills and address PTSD. Data collection was centered around five essential survey tools administered to teams. An additional matched-pairs study was conducted using untrained women from the region as a control. Ultimately, the team found that Global Grassroots is achieving its mission, vision, and theory of change — that its long-term goals are being met by operational methodology. However, to more thoroughly verify Global Grassroots’ theory of change, additional testing is required, with increased academic rigor.

Introduction

Twenty years after the genocide, Rwanda is still recovering from the waves of ethnic violence that decimated a population—leaving 800,000 dead—destroyed villages, and orphaned thousands (Human Rights Watch). While reconstruction and reconciliation within the country has occurred, and is occurring, at a faster rate than seen in any other post-genocide nation, there are still difficult odds to overcome. President Paul Kagame’s desire to build concentrations of industry and expertise has enabled the country to build a competitive advantage in coffee, tea, and tourism, and while much has been done to expand infrastructure in Rwanda, little is known about the widespread psychological effects of the genocide on the current populous (African Development Bank). Global Grassroots’ is one of the few NGO’s seeking to provide beneficiaries with both mindfulness training—to address the well-being of women in post-conflict areas—and business training to help women and girls maximize the impact of venture funding for social good.
Funded by the Jefferson Public Citizens at the University of Virginia, a team of four undergraduate researchers spent eight weeks living in Kigali, Rwanda and traveling around the region to assess the impact of 55 Global Grassroots funded ventures. Working closely with staff in the local Global Grassroots office, the team conducted interviews and administered surveys to assess the impact of the ventures on their target populations and their reported levels of PTSD, to be compared to baseline surveys conducted during initial team training and prior assessments (the most recent being done in 2011).

The primary aim of the in-country project was to gather data on the three levels of impact: individual, organizational, and social. Seeking to add statistical rigor to the collection of that data, the 2014 research team designed methods that would allow reliable assessment of Global Grassroots’ efficacy in achieving its mission, vision, and theory of change. Most specifically, the team sought to test the efficacy of pairing business and mindfulness training programs in the hopes of contributing to the wider body of knowledge on mindfulness techniques. Ultimately, the team hoped to not only provide a report for Global Grassroots on the status of venture operations and recommendations for organizational reform, but to research the methodology of mindfulness and draw conclusions on its efficacy.

Because the scale of Global Grassroots’ work is so extensive, the research team limited their assessment of venture impact insofar as it aided them in analyzing the success of the Academy for Conscious Social Change, Global Grassroots’ training program for girls and women.
Geographically, this project focused on the organization’s work in Rwanda and Uganda—with the majority of data collected on the many women’s ventures in Rwanda. It should be noted the team’s work interviewing girls operating ventures for University scholarships in Uganda would not have been possible without the support of Global Grassroots’ partner, the Cornerstone Development School. While this report does not aim to assess Cornerstone’s operations, their role in selecting scholarship candidates and potential venture leaders was invaluable.

Methodology

The methodology of the project can be subdivided into three rough categories: design, implementation, and synthesis. This Impact Assessment was designed in the winter and spring of 2014 by a research team of four students at the University of Virginia, working with faculty from the Batten School of Leadership and Public Policy. The research team worked closely with Global Grassroots to understand the context and background information discussed above, and to identify the aims and structure of the process. Among other information, the research team was given the following tools:

a. General Assessment Form – series of interview questions that gather qualitative data on the venture’s progress, individual impact, and organizational impact.

b. Pre-Training and Post-Training Questionnaires – surveys that gather quantitative and qualitative data on individual impact.
c. **PCL-17 Survey** – survey that gathers self-disclosed quantitative data on indicators of post-traumatic stress.

d. **Nonprofit Management Scorecard** – series of metrics that allow the researcher to quantitatively score a venture’s organizational capacity.

e. **Issue Studies** – survey designed and implemented by each venture (in conjunction with Global Grassroots) to quantify that venture’s social impact.

From May 30th to July 26th, the research team collected data while based in Kigali, Rwanda. The team completed 68 interviews with 35 ventures. 26 of those teams operate in Rwanda, and 9 in Uganda. 19 of those teams were long-standing teams, 4 were inactive, and 12 were recently launched.

The project was made possible by the hard work and talent of Global Grassroots’ Founder and CEO, Gretchen Wallace, and Global Grassroots’ Rwandan office, led by Gyslaine Uwitonze. The team also surveyed 52 control group participants to isolate the effect of Global Grassroots’ training. The control group had 32 participants in Rwanda’s capital city, Kigali, and 20 participants in a rural Rwandan town, Byimana.

The control groups were designed as a matched pairs study, where participants are reflective of the research group for as many variables as possible. The control participants were matched by gender, age, leadership experience, income, and geography. Each control group participant completed a PTSD survey and a post-training assessment.

The final stage of the Impact Assessment project was the synthesis of data into coherent findings, accurate evaluations, and actionable recommendations. The research team continued to work closely with faculty in the Batten School of Leadership and Public Policy to vet statistical models for academic rigor. Though the data analysis mainly required easily replicable calculations of mean, mode, and percentages, the team used a multivariate regression to determine the correlation between observed changes and Global Grassroots’ training.

### Data and Data Analysis

The data collected reflects significant improvements in the economic status and personal wellbeing of Global Grassroots’ trainees relative to 2011. Both trends match the qualitative evidence gathered in the team’s interviews. For instance, trainees’ ability to lend money to neighbors more than doubled since 2011. Families also feel such economic benefits. The numbers of trainees unable to pay for their children’s schooling dropped by one third, from 15 percent to 10 percent, and 96 percent of the children of trainees have health insurance. In comparison, control group participants were unable to pay for school for 36 percent of their children, and only 63 percent of the children have health insurance. The one category that did not have a positive
trend, the participant’s sense of power, did not become negative; it simply normalized. The latter data, reflecting participants’ levels of hope and happiness, are less strongly correlated to Global Grassroots’ program but are still statistically significant in suggesting that trainees’ levels of hope and happiness have increased since entering the program.

<table>
<thead>
<tr>
<th>CHANGE IN PARTICIPANTS’ WELLBEING OVER TIME</th>
<th>2009</th>
<th>2011</th>
<th>2014</th>
<th>% Change</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Difficulty of Life</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat Difficult</td>
<td>29.41%</td>
<td>16.28%</td>
<td>29.79%</td>
<td>82.99%</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>44.12%</td>
<td>48.84%</td>
<td>44.68%</td>
<td>-8.52%</td>
<td></td>
</tr>
<tr>
<td>Somewhat Easy or Comfortable</td>
<td>0.00%</td>
<td>9.30%</td>
<td>6.38%</td>
<td>-31.40%</td>
<td></td>
</tr>
<tr>
<td>Very Comfortable</td>
<td>0.00%</td>
<td>4.65%</td>
<td>4.26%</td>
<td>-8.39%</td>
<td></td>
</tr>
<tr>
<td><strong>Children</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average # of children living in household</td>
<td>3.7</td>
<td>3.52</td>
<td>3.72</td>
<td>5.68%</td>
<td>More children attending school</td>
</tr>
<tr>
<td># of children living in home unable to attend school</td>
<td>47.24%</td>
<td>18.16%</td>
<td>12.00%</td>
<td>-33.92%</td>
<td></td>
</tr>
<tr>
<td><strong>Food</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average # of meals eaten per day</td>
<td>2.20</td>
<td>2.40</td>
<td>2.48</td>
<td>3.33%</td>
<td>Slight increase</td>
</tr>
<tr>
<td>% reporting a change in family’s economic situation due to social change project</td>
<td>n/a</td>
<td>23.26%</td>
<td>46.81%</td>
<td>101.25%</td>
<td>Significant increase in economic status</td>
</tr>
<tr>
<td><strong>Economic Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powerless</td>
<td>9.38%</td>
<td>4.44%</td>
<td>0.00%</td>
<td>-100.00%</td>
<td>Normalization in sense of power</td>
</tr>
<tr>
<td>Not Very Powerful</td>
<td>12.50%</td>
<td>4.44%</td>
<td>6.38%</td>
<td>43.69%</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>34.38%</td>
<td>35.56%</td>
<td>51.06%</td>
<td>43.59%</td>
<td></td>
</tr>
<tr>
<td>Some Power</td>
<td>37.50%</td>
<td>28.89%</td>
<td>27.66%</td>
<td>-4.26%</td>
<td></td>
</tr>
<tr>
<td>Powerful</td>
<td>6.25%</td>
<td>26.67%</td>
<td>14.89%</td>
<td>-44.17%</td>
<td></td>
</tr>
<tr>
<td><strong>Sense of Power: Personal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powerless</td>
<td>6.67%</td>
<td>2.27%</td>
<td>0.00%</td>
<td>-100.00%</td>
<td>Normalization in sense of power</td>
</tr>
<tr>
<td>Not Very Powerful</td>
<td>10.00%</td>
<td>6.82%</td>
<td>11.11%</td>
<td>62.90%</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>46.67%</td>
<td>38.64%</td>
<td>44.44%</td>
<td>15.01%</td>
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</tr>
<tr>
<td>Some Power</td>
<td>36.67%</td>
<td>29.55%</td>
<td>24.44%</td>
<td>-17.29%</td>
<td></td>
</tr>
<tr>
<td>Powerful</td>
<td>0.00%</td>
<td>22.73%</td>
<td>13.33%</td>
<td>-41.36%</td>
<td></td>
</tr>
<tr>
<td><strong>Sense of Power: Family</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Powerless</td>
<td>19.35%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>Increase in sense of community power</td>
</tr>
<tr>
<td>Not Very Powerful</td>
<td>19.35%</td>
<td>9.52%</td>
<td>15.56%</td>
<td>63.13%</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>25.81%</td>
<td>50.00%</td>
<td>35.56%</td>
<td>-28.88%</td>
<td></td>
</tr>
<tr>
<td>Some Power</td>
<td>25.81%</td>
<td>30.95%</td>
<td>40.00%</td>
<td>29.24%</td>
<td></td>
</tr>
<tr>
<td>Powerful</td>
<td>9.68%</td>
<td>9.52%</td>
<td>8.89%</td>
<td>-6.62%</td>
<td></td>
</tr>
<tr>
<td><strong>Sense of Power: Community</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No hope at all</td>
<td>n/a</td>
<td>0.00%</td>
<td>0.00%</td>
<td>0.00%</td>
<td>Increase in reported hopefulness</td>
</tr>
<tr>
<td>Not very hopeful</td>
<td>n/a</td>
<td>1.96%</td>
<td>0.00%</td>
<td>-100.00%</td>
<td></td>
</tr>
<tr>
<td>A little bit hopeful</td>
<td>n/a</td>
<td>5.88%</td>
<td>6.38%</td>
<td>8.50%</td>
<td></td>
</tr>
<tr>
<td>Somewhat hopeful</td>
<td>n/a</td>
<td>9.80%</td>
<td>19.15%</td>
<td>95.41%</td>
<td></td>
</tr>
<tr>
<td>Hopeful</td>
<td>n/a</td>
<td>56.86%</td>
<td>61.70%</td>
<td>8.51%</td>
<td></td>
</tr>
<tr>
<td>Very Hopeful</td>
<td>n/a</td>
<td>9.80%</td>
<td>10.64%</td>
<td>8.57%</td>
<td></td>
</tr>
<tr>
<td>No response</td>
<td>n/a</td>
<td>15.69%</td>
<td>2.13%</td>
<td>-86.42%</td>
<td></td>
</tr>
<tr>
<td><strong>Hopefulness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very sad</td>
<td>n/a</td>
<td>1.96%</td>
<td>0.00%</td>
<td>-100.00%</td>
<td>Significant increase in reported happiness</td>
</tr>
<tr>
<td>Sad</td>
<td>n/a</td>
<td>0.00%</td>
<td>10.64%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat sad</td>
<td>n/a</td>
<td>5.88%</td>
<td>4.26%</td>
<td>-27.55%</td>
<td></td>
</tr>
<tr>
<td>Neither happy nor sad</td>
<td>n/a</td>
<td>13.73%</td>
<td>19.15%</td>
<td>39.48%</td>
<td></td>
</tr>
<tr>
<td>Somewhat happy</td>
<td>n/a</td>
<td>21.57%</td>
<td>19.15%</td>
<td>-11.22%</td>
<td></td>
</tr>
<tr>
<td>Happy</td>
<td>n/a</td>
<td>21.57%</td>
<td>40.43%</td>
<td>87.44%</td>
<td></td>
</tr>
<tr>
<td>Very happy</td>
<td>n/a</td>
<td>17.65%</td>
<td>6.38%</td>
<td>-63.85%</td>
<td></td>
</tr>
<tr>
<td>No response</td>
<td>n/a</td>
<td>17.65%</td>
<td>0.00%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
On the whole, Global Grassroots’ beneficiaries are happier and more hopeful than control group participants. Though control group participants were slightly more likely to identify as “very hopeful” or “very happy,” the data again reflect a normalization that fits with Global Grassroots’ mission in post-conflict settings. Only 14% of Global Grassroots’ participants identified as “somewhat sad” or “sad,” and 0% identified as very sad. In comparison, a group of control group participants with comparable economic levels education, and family structures identified as “somewhat sad” or “sad,” but control group participants were much more likely to report feeling “very sad” or “neither happy nor sad” than research group participants. Similarly, 0% of beneficiaries felt “no hope” or “not very hopeful,” compared to the one sixth of control group participants who selected those answers.

To test whether the observed changes in the experimental group were the effect of Global Grassroots’ training, we ran multiple regression models on data collected in the baseline assessment surveys. These models determine the correlation between various independent variables and a dependent variable of choice. For this research, we tested multiple dependent variables that indicated impact on two broad categories: economic wellbeing and personal wellbeing.
Findings

Our models suggest that the two best predictors of positive change in an individual’s economic well-being are Global Grassroots' training and level of education. Global Grassroots trainees eat more meals on average per day, provide a greater percentage of their children with health insurance, send a higher percentage of their children to school, and are more likely to be able to lend money to a neighbor in need. In particular, whether or not an individual received training from Global Grassroots has a statistically significant correlation to an increase in average meals per day and the percentage of children in the home with health insurance. Though the correlation is weak, Global Grassroots can be reasonably certain that the Academy for Conscious Social Change will improve a trainee’s economic well-being.

Whether an individual received Global Grassroots training was also the single best predictor of positive change in personal wellbeing. Most strikingly, women who are trained are less likely to view their life as difficult. Training was also correlated with the power individuals felt over their personal and familial circumstances, with trained women exhibiting higher levels of power. This correlation did not hold for power felt over community circumstances, however. Thus, Global Grassroots can be reasonably certain that the Academy for Conscious Social Change will alter a trainee’s sense of agency. Thus, the individual data proves with reasonable certainty that intervention is beneficial on an individual’s economic and personal well-being. Global Grassroots can also be confident that its stated objective of 75 percent of participants reaching a normalized sense of personal power has been met (93.6% of participants feel a normalized sense of personal power) because of the skills transferred by the training program.

Conclusion

Global Grassroots has continued to positively impact the individuals, ventures, and communities that it has worked with since 2011. Changes to economic status, physical well-being, leadership, and community initiatives are well documented and encouraging. In support of the initial hypothesis, the team found that mindfulness training is especially important for women in post-conflict environments and measuring the efficacy of the programs provides a very tangible benefit to an NGO with limited resources, and to the growing interest in mindfulness practices and learning in development work.

Both the quantitative and qualitative data provide clear evidence that Global Grassroots’ beneficiaries feel empowered and qualified to be active change agents in their communities. Their training from Global Grassroots, along with their level of education, is the greatest predictor of greater economic well-being. This economic stability has given trainees an opportunity to better support their children, families,
and neighbors through the purchase of health insurance, the payment of school fees, and the ability to lend money to others in need.

References


Biographies

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Mark Heneine is from Atlanta, Georgia studying Philosophy and Mathematics. (Class of 2016)

Claire Councill is from High Point, North Carolina studying Art History and Economics. (Class of 2017)

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Long-Term Testing of Ceramic Water Treatment Technologies in Limpopo Province, South Africa

Chloe Rento, Veronica Son, Sydney Turner

Each year an estimated 3.4 million deaths are due to waterborne illnesses, as a result long term effective solutions to provide safe drinking water are essential. A one year study was conducted in Limpopo, S. Africa to assess the efficacy of three POU technologies: the MadiDrop, ceramic water filters (CWF), and the CWF and MadiDrop used together. The MadiDrop is a silver embedded ceramic tablet that to provides continual disinfection through the release of silver. 80 households were enlisted and provided one of the POU technologies, and water quality analysis was performed for silver levels and disinfection of total coliform bacteria. After one year of use, the combination of the CWF and the MadiDrop, the CWF, and the MadiDrop had a median reduction of 72%, 99%, and 99% in total coliform bacteria, respectively. Focus groups were also conducted to evaluate the effectiveness of the instructional pamphlets for both technologies. Few participants in the focus group learned the proper maintenance techniques for the CWF, but the MadiDrop instructions for use seemed easier to follow. Accompanied by an instructional pamphlet that is concise and easy to understand, these technologies could improve the water quality and health of those without access to improved drinking water sources.

Introduction

The World Health Organization estimates that 748 million people still lack access to an improved drinking water source, of which 90% live in rural areas and 43% live in sub-Saharan Africa (WHO 2014). Lack of access to clean drinking water supplies contributes to the burden of waterborne disease in developing communities, especially among children 5 years old and younger (Pruss 2002). In S. Africa, 13% of the population does not have access to improved water supply, the majority of which live in rural communities (WHO 2014). To address this, the long term performance of three point-of-use (POU) technologies were evaluated: the MadiDrop, ceramic water filters (CWF), and the CWF and MadiDrop combined, as shown in Image 1. The silver impregnated ceramic water filter (CWF) was manufactured by a nongovernmental organization, PureMadi (PM), at the Mukondeni Pottery Cooperative in Limpopo, S. Africa and the MadiDrop, a silver impregnated ceramic disk, was designed and manufactured by researchers at the University of Virginia (Ehdaie et. al 2014). Both technologies use silver in a ceramic medium to purify water. The CWF uses physical and chemical filtration methods to remove bacteria, protozoa, and turbidity. The MadiDrop diffuses silver ions into the water at a controlled rate to chemically disinfect water, allowing it to be used alone or as a secondary POU method to provide continuous disinfection of treated water. When both technologies are used in conjunction, the water is treated primarily through filtration and continually disinfected using the MadiDrop.
While both technologies provide potable water when used alone, they may also be used together to reduce rates of recontamination. In a previous study of CWFs in Guatemala, Kallman et al. found that improper handling of the filters caused recontamination of the filtered water (2010). A CWF+MadiDrop POU water treatment system, would help reduce this recontamination of the filtered water and the formation of a biofilm in the lower reservoir of the bucket through the silver released from the tablet.

A schematic of the MadiDrop (1A), the CWF (1B), and the MadiDrop and CWF combination (1C).

In the summer of 2013, these three POU methods were evaluated for efficacy in the villages of Mashamba and Tshibvumo in Limpopo Province. Before conducting the study, the team met with the chiefs of both villages to receive permission to conduct field research in the villages. In Tshibvumo 25 households were given a CWF, and 25 households were given both a CWF and a MadiDrop. In Mashamba, 30 households were given a silver-impregnated MadiDrop and a control MadiDrop without silver. Weekly samples were collected and after one week of use, the MadiDrop achieved a median reduction in total coliform bacteria of 75%. The CWF achieved a median reduction of 100%, and the combination of the CWF and MadiDrop achieved a median reduction of 100%.

**Current Project**

During the summer of 2014, the JPC team traveled back to South Africa to evaluate the effectiveness of the three POU methods after 1 year of use. This project was a continuation from the study done in the summer of 2013, and 73 of the original 80 households were able to be contacted and revisited for sample collections.
Methods

In the summer of 2014, three rounds of water samples were collected biweekly for six weeks from each of the 73 households in Tshivbumo and Mashamba. For all water samples, approximately 500 mL of water were collected using sterile Whirl-Pack stand-up bags. All influent samples were collected from the container in which the participant would typically store water from a river or the community faucet. All of the effluent samples were collected from the spigot of the bucket the residents had in the homes. Using the laboratories at the University of Venda in Limpopo, water samples were analyzed for total coliforms and *E. Coli* using membrane filtration. A graphite furnace atomic adsorption spectrometer was used to measure total silver levels in water samples.

Focus groups were also conducted with 18 villagers in Tshivvumo to test the effectiveness of the instructional pamphlets that accompany the CWF and MadiDrop. Participants did not have previous knowledge about the CWF and were invited to participate by the village chief. Participants were shown an instructional pamphlet for the CWF or the MadiDrop for the first time and then were asked to demonstrate the proper techniques for using either technology to test their comprehension of the pamphlets. In addition, participants were asked to respond to questions regarding the clarity and ease of use of the instructions.

Results

Evaluating Technical Performance

Figure 1 shows data collected in the villages of Tshivvumo and Mashamba that represents the median percent reduction in bacteria produced by the Madidrop, the CWF, and a combination of the two after both the first week and the first year of use. The MadiDrops, the CWF, and the CWF with MadiDrop achieved a median percent reduction in total coliform bacteria after one year of use of 72%, 99%, and 99%, respectively.

![Figure 1](image.png)

*Reduction in total coliform bacteria from three technological interventions after 1 week and 52 weeks of use.*
Figure 2 represents the average total silver levels released by the three technologies after both the first week of use and the first year of use. Silver concentrations of the MadiDrop after a year remained almost constant at 2.255 parts per billion (ppb), while the CWF and the CWF with MadiDrop combination decreased after a year to 28.3 ppb and 17.1 ppb, respectively.

**Figure 2**

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Week 52</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg</td>
<td>Std Error</td>
</tr>
<tr>
<td>Madidrop</td>
<td>2.67</td>
</tr>
<tr>
<td>CWF</td>
<td>46.6</td>
</tr>
<tr>
<td>CWF + MadiDrop</td>
<td>54.8</td>
</tr>
</tbody>
</table>

*Total silver concentrations for the MadiDrop, the CWF, and the CWF and MadiDrop after 1 week and 52 weeks of use.*

**Evaluating Instructional Pamphlets**

The focus groups illuminated the strengths and weaknesses of the instructional pamphlets. The instructions for the CWF confused many participants and was not very effective at relaying instructions for use. For example, only 17% of the participants understood what the proper maintenance methods were for the filter, and 6% learned the correct lifespan of the filter. However, 89% of participants would like a built-in calendar to monitor the filter cleaning schedule. The MadiDrop instructions seemed easier to understand. Only 6% of participants did not learn how much time was required for disinfection. Additionally, 44% correctly identified the lifespan of the MadiDrop.

**Discussion**

Measured for the first time in a long term study, the MadiDrop, the CWF, and the CWF with MadiDrop were shown to still reduce total coliform bacteria after one year of use. The results show that the greatest percent reduction for total coliform bacteria is achieved when combining the CWF and the MadiDrop. As expected, silver levels declined the most in the conditions involving a CWF, most likely due to silver being
washed off the ceramic surface as water continually flowed through it, as compared to the MadiDrop alone that was able to sustain a continuous release of silver.

While the focus groups proved to be very informative, there were some limitations to their effectiveness. Only 18 people were evaluated, and such a small group may not be entirely representative of the entire target population. The study sessions lasted for a long amount of time, which could have tired or bored participants. Therefore, answers given at the end of the study could be less accurate. Overall, however, the focus groups provided good feedback for improvement on the instructional pamphlets for each technology.

The data collected this summer proves that these technologies can improve water quality for long periods of time, making them more desirable and effective than other current POU technologies. The data will allow us to further optimize and effectively market the products, which have the potential to significantly alleviate the potable water crisis in the developing world.

References


Biographies

Beeta Ehdaie is a doctoral candidate in the Civil and Environmental Engineering department.

Chloe Rento, currently a third year student of the University of Virginia, is pursuing an undergraduate degree in Chemical Engineering.

Veronica Son, currently a third year student of the University of Virginia, is pursuing an undergraduate degree in Civil and Environmental Engineering.

Sydney Turner, currently a fourth year student of the University of Virginia, is pursuing an undergraduate degree in Civil and Environmental Engineering.
Hope Through Mobility

Ali Hazel, Chris Cai, Usnish Majumdar, and Sreemoyee Som
Mentors: Paul Matherne, M.D., Rebecca Scharf, M.D., Paige Pullen, Ph.D

Disability is a complex phenomenon based on the interaction between a person’s physical abilities and the social response from the community in which they reside. Our work in Lusaka, Zambia was in partnership with Special Hope Network (SHN), a non-governmental organization that provides motor play and educational services to over 100 Lusakan children with cognitive and physical disabilities. While addressing SHN’s need for affordable therapy tools, our team gained valuable industrial and medical contacts in Lusaka and developed close personal relations with the Zambian Association for Children with Disabilities (ZACD), the primary supplier of products purchased by SHN. In response to needs identified by both SHN and ZACD, our team is currently collaborating with ZACD to implement quality controls for consistently manufacturing and labeling inventory of their pediatric standing frame product. The team hopes to eventually partner with occupational therapists from University of Virginia Hospital and medical facilities in Lusaka (such as Beit Cure, Italian Orthopedic Hospital, and University Teaching Hospital) to evaluate the standers and construct a user’s manual with guidelines for recommended use.

Introduction

Zambia faces considerable challenges in addressing the needs of the disabled. While a significant proportion (15%, International Labour Organization, 2006) of Zambians are reported to live with disabilities, recent disability policy has not yet translated to benefits for one of Zambia’s most vulnerable populations: children with severe physical and cognitive disabilities (Collins, Simwanza, & Mumbi, 2009). In Lusaka and other Zambian regions, children with disabilities and their caretakers face regular, pervasive stigmatization and discrimination from friends, family, the community, and even healthcare providers (Kapungwe et al., 2010). Few facilities are disability-friendly and children with disabilities are often hidden in shame by their families. These adverse conditions may have many direct health consequences, preventing these people from living productive, satisfying lives (Nixon et al., 2011). Our partner organization, Special Hope Network (SHN), is one of few organizations that exclusively address the needs of children with intellectual and developmental disabilities in Lusaka.

Of the wide range of disabilities that affect Zambian children, cerebral palsy and hydrocephalus are two of the most common – both of these conditions can limit a child’s ability to walk or perform voluntary movements (Hydrocephalus Fact Sheet). A common occurrence in these disorders is the presence of consistently low or consistently high muscle tone - the latter results in contractures that cause extremely rigid joints and long-term tissue deformity. Though the physical aberrations in these pediatric patients are often symptoms of an underlying condition, there are many
benefits to directly addressing them through physiotherapy. For example, standing frames, devices that help patients bear weight in an upright, standing position, have been shown to improve lower limb contractures in non-ambulatory pediatric populations with cerebral palsy (Gibson et al., 2009). As the population for whom SHN designs motor play interventions are largely non-ambulatory with high incidence of cerebral palsy or other conditions involving hypo and hypertonia, standing frames are one of the most common assistive medical devices used in their facilities (Figure 1). There is great need for these devices among both the growing population served by SHN as well as among other disability organizations served by ZACD in sub-Saharan Africa.

**Methodology**

During initial communications with SHN, three project goals were identified, (1) to implement a new metric that would allow for periodic evaluation of pediatric functional capabilities, (2) to perform an initial analysis of improvements that could be made to the design and production of relevant assistive medical devices, and (3) to map resources around Lusaka for the production of such assistive devices. While preparing for this trip with University of Virginia physicians and professors, the Pediatric Evaluation of Disability Inventory - Computer Assisted Test (PEDI-CAT) was identified as a potentially applicable measure. The PEDI-CAT is an electronically administered assessment that measures three functional domains - Daily Activities, Mobility and Social/Cognitive Domains (Kramer, 2012). Questions about the patient’s abilities are dynamically selected based on previously provided answers, thereby reducing the time required to complete the test and eliminating irrelevant questions obviously beyond the patient’s capacity.

Multiple studies have found the PEDI-CAT to be both reliable and valid in assessing functional development (Dumas et al., 2012 and Hayley et al., 2011). In addition,
the PEDI-CAT has been demonstrated to retain its validity and reliability in linguistic and cultural contexts outside the United States (Erkin et al., 2007). For our uses, the PEDI-CAT was selected because it is (1) easily and quickly administered via portable tablets at the sites of community centers, and (2) accompanied by pictures that assist in explaining actions it describes (e.g. “When lying on back, [patient] reaches for toy”) to non-English-speaking caregivers.

After volunteering at SHN centers for two weeks, working alongside the instructors employed by SHN (Figure 2) and familiarizing ourselves with the patient population (Figure 3) we determined that we would administer a few test trials of the PEDI-CAT to relatively high-functioning subjects. However, our team encountered several difficulties in implementing the PEDI-CAT in Lusaka. PEDI-CAT evaluates motor function through questions about a child’s everyday life and activities, but many such
questions involve technologies or structures that do not readily translate to life in Lusaka. For example, a series of questions that ask about a child’s ease in navigating stairs with or without a railing, while an innocuous query in the US, fails to account for the fact that most households in Lusaka are single-storied and the only major stairwells are found at hotels and large malls — areas that were socioeconomically exclusive for many households served by SHN. Even for culturally applicable questions, it was difficult to ascertain whether non-English-speaking caregivers had fully comprehended the question. The formal process for incorporating Town Nyanja (Lusaka’s local language, among a mosaic of languages spoken in Zambia) translations into the PEDI-CAT software involved a several-month-long process that could not be completed before traveling to Lusaka; nevertheless, one of SHN’s workers graciously agreed to translate while we administered the evaluation. Such on-site translation and follow-up explanations were very difficult and time-consuming for both the caregiver and the translator. Also, because most of the children tested scored very low on the functional scale (Figure 4) many mothers were subjected to large groups of questions regarding tasks their child clearly could not accomplish, a potentially challenging and demeaning experience.

To address SHN’s other indicated need for improved assistive devices, the team began mapping relevant resources around Lusaka to locate materials used to construct assistive devices (i.e. metals, hardware, etc.), contract craftsmen with the necessary tools for constructing structures from these materials, and contact all other organizations that provide disability equipment or services:
<table>
<thead>
<tr>
<th>Group/Organization</th>
<th>Description of Action</th>
<th>People &amp; Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special Hope Network</td>
<td>Our community partner. Provides schooling and therapy for children with intellectual and physical disabilities</td>
<td>Eric &amp; Holly Nelson, Local Workers (Milika)</td>
</tr>
<tr>
<td>Zambian Association for Children with Disabilities</td>
<td>Builds special chairs / standers, employs disabled adults, primary supplier of SHN</td>
<td>Chrispine and Geoffrey Mwale, Co-Founders</td>
</tr>
<tr>
<td>Beit CURE Hospital</td>
<td>Provides pediatric surgery and therapy for disabled children; also houses ZACD</td>
<td>Victor Chabala, Program Manager Tim Ebbers, Executive Director</td>
</tr>
<tr>
<td>Italian Orthopaedic Hospital</td>
<td>Provides orthopedic limbs to amputees around Zambia</td>
<td>Keine Chabene, Field Tech</td>
</tr>
<tr>
<td>Disacare</td>
<td>Constructs wheelchairs and orthopedic tricycles</td>
<td>Kenny Mubuyaeta, Manager and Worker</td>
</tr>
<tr>
<td>Action Zambia Ministries</td>
<td>Equips local churches to respond to local structural and health-related needs</td>
<td>Tyler Dingman, contact with Metal sellers and welders</td>
</tr>
<tr>
<td>Zambikes</td>
<td>Sells bikes built in Lusaka, also constructs an all-terrain “bike ambulance”</td>
<td>Tiki Mambwe, Sales Manager Vaughn Spethmann, Co-Founder</td>
</tr>
<tr>
<td>Archie Hinchcliffe Disability Intervention</td>
<td>Provides therapy to children with disabilities</td>
<td>Violet Sitwala, Director</td>
</tr>
<tr>
<td>Cerebral Palsy Africa</td>
<td>Runs short training courses to start specialist therapy training</td>
<td>Archie Hinchcliffe, Founder</td>
</tr>
<tr>
<td>APTERS / University Teaching Hospital</td>
<td>Works in similar capacity to ZACD - building special chairs / standers / furniture, employing disabled adults</td>
<td>Lucie Kasanga</td>
</tr>
</tbody>
</table>

It was determined that strengthening the capabilities of the manufacturer from whom SHN purchases these products was more appropriate than creating a new partnership with another organization and attempting to design novel assistive devices. The director of SHN had given anecdotal evidence expressing a need for improvement in the devices produced by ZACD -- for example, when manufacturing an assistive seating device, ZACD had difficulties delivering their seating frame product with
an additional pommel; the modification was intended to compel a pediatric user to sit upright. When ordering assistive devices from ZACD, executive staff at SHN with no formal background in designing assistive mobility devices often proposed design modifications. There was an opportunity for more standardization in production and certification of technicians manufacturing these devices. However, both organizations expressed a desire for validated devices evaluated by an authority on the subject. The student team worked with ZACD to understand the process for manufacturing the two products most commonly purchased by SHN: 1. a seating device with an optional variation for patients with hydrocephalus and 2. a standing frame. ZACD also shared relevant information regarding their executive structure, suppliers, benefactors, and stakeholders to facilitate the student team’s ability to provide recommendations calibrated to the network surrounding ZACD. Equipped with knowledge of the organizational structures and professed needs of both SHN and ZACD, the team determined that they were best equipped to address the common needs of both organizations by providing suggestions regarding the manufacturing protocol and recommended usage of a single, well-understood product: the pediatric standing frame.

The design for the pediatric standing frame manufactured at ZACD originated from a workshop in the early 1990s hosted by a British physiotherapist who trained local craftsmen to cut, piece, and polish assistive mobility products entirely from locally sourced materials. The ZACD standing frame manufacturing process involves the following steps:

<table>
<thead>
<tr>
<th>Manufacturing Steps</th>
<th>Time Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Creating large, thick slabs of corrugated cardboard by placing a heavy weight on</td>
<td>24-48 hours</td>
</tr>
<tr>
<td>two individual pieces affixed with a thickened paste composed of wheat flour and</td>
<td></td>
</tr>
<tr>
<td>water (Figure 5)</td>
<td></td>
</tr>
<tr>
<td>2. Drafting and cutting individual parts from the double-wide sheets of cardboard</td>
<td>2 hours</td>
</tr>
<tr>
<td>3. Assembling the individual parts in the correct orientation with wood glue</td>
<td>1 hour</td>
</tr>
<tr>
<td>4. Covering the entire structure with newsprint and wheat paste, taking special</td>
<td>2 hours</td>
</tr>
<tr>
<td>care to connect joints</td>
<td></td>
</tr>
<tr>
<td>5. Allowing the newsprint-covered scaffold to dry completely</td>
<td>6 hours</td>
</tr>
<tr>
<td>6. Covering the entire structure with a second coat of wheat paste and thicker</td>
<td>2 hours</td>
</tr>
<tr>
<td>brown paper with a smooth finish</td>
<td></td>
</tr>
<tr>
<td>7. Allowing the brown-papered scaffold to dry completely</td>
<td>6 hours</td>
</tr>
<tr>
<td>8. Painting the final structure</td>
<td>2 hours</td>
</tr>
</tbody>
</table>
It must be noted that the estimated time required to complete each manufacturing stage is based on a single ZACD employee working independently in dry and sunny weather as experienced by the student team during their travels. As the manufacturing environment is entirely open to the elements, production during the wet season is not considered within the scope of this paper (Figure 6). Anecdotally, their wet season production was lower and the drying of the paste in Step 1 took a significantly longer time.

**Results**

Given the clear problems with administering the PEDI-CAT at SHN centers and the limited time during which the student team was on-site, it was concluded that an un-revised PEDI-CAT was not an effective metric for routine evaluation of populations served by SHN. Modifications that facilitate caregiver understanding of the questions and replace frequently invalidated prompts with culturally relevant ones may allow future implementation of the PEDI-CAT within SHN’s centers.

Regarding the manufacturing process for ZACD standing frames, though the sequence of steps outlined previously was largely followed in the construction of every standing frame, it was observed that Step 2 introduced many product variations: the measurements for all dimensions on each part were not defined and angles were approximated by eye without use of a steel square or protractor. Furthermore only one person on the
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ZACD team was able perform this step. Therefore, though it is not the most time-intensive manufacturing stage, it is the most labor-intensive and can create a bottleneck in the ZACD manufacturing process when the organization receives orders of high volume (Figure 7). The student team is hoping to propose the following modifications to this manufacturing protocol:

1. Using prefabricated stencils that can be traced to draft all parts of the standing frame, thereby both reducing the time required to complete Step 2 and increasing the number of people on the ZACD team that can easily complete this step
2. Using steel squares and/or protractors to ensure standardized assembly of all parts
3. Marking the finished standing frame in a unique, permanent manner so that the specific device can be added to an inventory and tracked throughout its lifecycle

Discussion

The student team is currently in the process of identifying areas of overdesign or structural inadequacies within the design of the standing frame to recommend failure-based design modifications and outline the duration of use and advisable modes of placing loads on the device (Figure 8). Based on computationally performed preliminary stress analyses, using strength metrics for corrugated cardboard rather than the undoubtedly stronger composite used to manufacture the standers (Allaoui, 2011), the current design is well able
to bear a child’s load over multiple load cycles. We hope that reporting areas of over-design in tandem with our findings of structural stability (Figure 9) will increase eventually yield a more efficient manufacturing system that ZACD can adapt when producing other products. We also anticipate that a more standardized manufacturing process and future conversations with a physiotherapist in the field will assuage SHN regarding the efficacy of the ZACD standing frame, outline safe guidelines for its use, and suggest an array of appropriate patient-based design modifications. By making standers safer and easier to obtain, we hope to improve the prospects for the children with disabilities that the Special Hope Network serves.

References


Anti-Stigma Interventions for People Living in HIV and Disability in Zambia. Paper presented at Canadian Global Health Conference, Montreal, Canada


**Biographies**

Ali Hazel is a third-year undergraduate studying Political and Social Thought.

Chris Cai is a third-year undergraduate studying Human Biology.

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